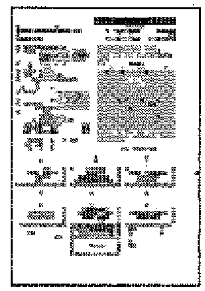
The Delphion Integrated View

Title: **JP2000184727A2: POWER SUPPLY CIRCUIT**

Derwent Title: Power supply circuit for discharge tube, includes detector which outputs current signal based on which continuation or non-continuation of load driving is performed after elapse of set delay time [Derwent Record]



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Priority Number: 1998-12-11 **JP1998000352995**

Abstract:

PROBLEM TO BE SOLVED: To provide a power supply circuit for performing an appropriate protection operation and power supply to a load accordingly by accurately discriminating the abnormal operation of a boosting circuit or the like and the stable standby state of the load.

SOLUTION: A load 302 is driven by a piezoelectric transformer 301 that is driven by a boosting circuit 304 being controlled by a frequency control circuit 303 and a drive voltage control circuit 311. An output voltage Vp2 of the piezoelectric transformer 301 and a load current Io of the load 302 are detected, and it is judged whether a value that is obtained by converting the load current Io to a voltage is equal to or less than a reference voltage Vs by a comparator 405. A delay circuit 402 sets long delay time when the load current Io is equal to or less than a reference and short delay time when an output voltage Vp2 that is equal to or more than a specific value is outputted. With the delay time (delay signal) as operation start time, a break circuit 403 controls the operation stop of an output system.

INPADOC Legal Status: None **Buy Now:** Family Legal Status Report

Family:

Buy PDF	Publication	Pub. Date	Filed	Title
	US6151232	2000-11-21	1999-12-13	Power supply circuit utilizing a piezoelectric transformer that supplies power to a load whose impedance varies depending on temperature
	TW0522756B	2003-03-01	1999-12-10	Power supply circuit

☑	KR0057052A	2000-09-15	1999-12-11	CIRCUIT FOR SUPPLYING POWER SOURCE
☑	**JP2000184727A2**	2000-06-30	1998-12-11	POWER SUPPLY CIRCUIT
☑	JP03061043B2	2000-07-10	1998-12-11	
5 family members shown above				

Other Abstract Info: DERABS G2000-487602 DERABS G2000-487602

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YAMAGUCHI SHUJI

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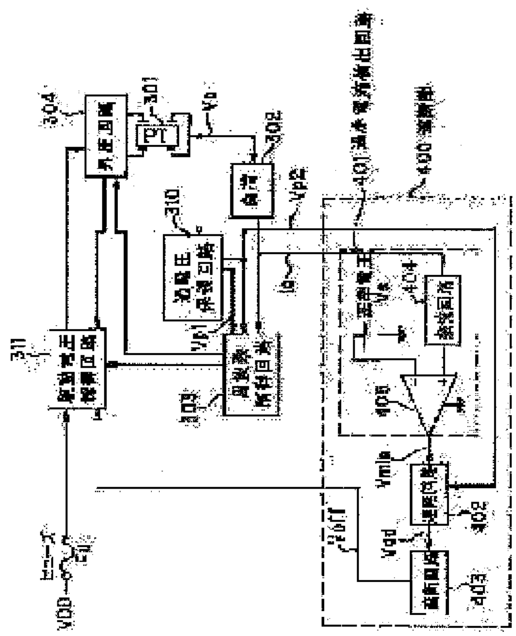
(54) POWER SUPPLY CIRCUIT

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a power supply circuit for performing an appropriate protection operation and power supply to a load accordingly by accurately discriminating the abnormal operation of a boosting circuit or the like and the stable standby state of the load.



SOLUTION: A load 302 is driven by a piezoelectric transformer 301 that is driven by a boosting circuit 304 being controlled by a frequency control circuit 303 and a drive voltage control circuit 311. An output voltage Vp2 of the piezoelectric transformer 301 and a load current Io of the load 302 are detected, and it is judged whether a value that is obtained by converting the load current Io to a voltage is equal to or less than a reference voltage Vs by a comparator 405. A delay circuit 402 sets long delay time when the load current Io is equal to or less than a reference and short delay time when an output voltage Vp2 that is equal to or more than a specific value is outputted. With the delay time (delay

signal) as operation start time, a break circuit 403 controls the operation stop of an output system.

LEGAL STATUS

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[Patent number]	*3061043*
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CLAIMS

[Claim(s)]
[Claim 1] In the power circuit which drives the load which carries out the pressure up of the driver voltage in a booster circuit, inputs into a primary piezoelectric transformer side, and has the large impedance of temperature dependence with the output voltage of the secondary of said piezoelectric transformer level predetermined in the load current which flows said load -- smallness -- the time -- a too little current signal -- outputting -- too little, when said too little current signal is outputted, a current detection means and It is the power circuit characterized by having the means for stopping which stops actuation of said booster circuit, and a delay means to set up the time delay according to the level of said output voltage, and said means for stopping determining activation and the nonfulfilment of said actuation based on the existence of said too little current signal when said time delay passes.
[Claim 2] said delay means is based on said temperature dependence of said load -- starting -- the maximum of time amount -- size -- the 1st time delay and the time amount to which said booster circuit results in a defect by abnormalities -- smallness -- the power circuit according to claim 1 characterized by setting up the 2nd time delay.
[Claim 3] For said delay means, said output voltage is the power circuit according to claim 2 characterized by setting up said 1st time delay when becoming size from a predetermined value.
[Claim 4] a value predetermined [means / said / delay] in said output voltage -- smallness -- the time -- said 2nd time delay -- setting up -- ** -- the description -- carrying out -- being according to claim 2 -- a power circuit .
[Claim 5] Said too little current detection means is a power circuit according to claim 1 characterized by detecting the load current of a cold cathode tube as said load.
[Claim 6] Said delay means is a power circuit according to claim 2 characterized by setting up 5 - 6 seconds as said 1st time delay, and setting up 0.05 - 0.15 seconds as said 2nd time delay.
[Claim 7] For said delay means, said output voltage is the power circuit according to claim 3 characterized by setting up said 1st time delay size from said predetermined value by connecting to juxtaposition the capacitor of an addition to the capacitor which sets up said 2nd time delay, when becoming.
[Claim 8] Said too little current detection means is a power circuit according to claim 1 characterized by having a rectification means to rectify said load current and to output a rectification signal, and a comparison means to compare said rectification signal and reference value and to output said too little current signal.
[Claim 9] Said means for stopping is a power circuit according to claim 1 characterized by stopping impression of said driver voltage to said booster circuit when performing said actuation.
[Claim 10] Said means for stopping is a power circuit according to claim 2 characterized by determining the nonfulfilment of said actuation when said delay means sets up said 1st time delay and said too little current signal has disappeared at the time of progress of said 1st time delay.
[Claim 11] Said means for stopping is a power circuit according to claim 2 characterized by opting for activation of said actuation when said delay means sets up said 1st time delay and said too little current

signal is continuing at the time of progress of said 1st time delay.
[Claim 12] Said means for stopping is a power circuit according to claim 6 characterized by opting for activation of said actuation after progress of 5 - 6 seconds when said cold cathode tube is not connected suitable for a load circuit.
[Claim 13] Said means for stopping is a power circuit according to claim 6 characterized by opting for activation of said actuation after progress of 5 - 6 seconds when not turning on said cold cathode tube.
[Claim 14] Said means for stopping is a power circuit according to claim 2 characterized by opting for activation of said actuation after progress of 0.05 - 0.15 seconds when said booster circuits are abnormalities.
[Claim 15] In the power circuit which drives the load which has the impedance which carries out the pressure up of the driver voltage in a booster circuit, inputs into a primary piezoelectric transformer side, and has temperature dependence with the output voltage of the secondary of said piezoelectric transformer level predetermined in the load current which flows said load -- smallness -- the time -- a too little current signal -- outputting -- too little, when said too little current signal is outputted, a current detection means and It has the means for stopping which stops actuation of said booster circuit, and a delay means to set up the time delay according to the level of said output voltage. Said means for stopping The power circuit characterized by determining the nonfulfilment of said actuation when said actuation is performed when the time check of said time delay is completed, and the time check of said time delay is interrupted on the way.
[Claim 16] Said delay means is a power circuit according to claim 15 characterized by inputting said too little current signal and clocking said time delay.
[Claim 17] Said delay means is a power circuit characterized by interrupting the time check of said time delay when the input of said too little current signal is interrupted.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the power circuit for performing current supply for the load from which an impedance tends [especially] to change through a piezoelectric transformer about a power circuit.
[0002]
[Description of the Prior Art] When abnormalities are detected working in the power circuit which makes the discharge tube etc. ****, in order to protect a load and a power circuit, it is necessary to stop a power outlet. As a conventional power circuit equipped with such a function, there are some which are shown in JP,4-070869,B and JP,10-052068,A.
[0003] Drawing 8 shows the 1st example of a configuration of the conventional power circuit, and the detail is shown in JP,4-070869,B. The load electrical-potential-difference detection means according [this power circuit] to resistance 112 and 113, the 1st reference voltage generating means by resistance 126 and the capacitor 127, The 2nd reference voltage generating means by resistance 123,124 and the capacitor 115, The power amplification section which consists of the IC section 100 which generates supply voltage based on two reference voltages and a load electrical-potential-difference detection value, resistance 104,107, a transistor 105, and the main transistor 106, It has the diode 109 for rectification connected to the secondary winding of the converter (transformer) 108 driven with the main transistor 106, and a converter 108, and the capacitor 110 which carries out smooth [of the output of this diode 109], and is constituted.
[0004] The IC section 100 The comparator 121 connected to the output transistor 102 which is connected to the comparator 101 and this comparator 101 into which the 1st reference voltage is inputted, and drives a transistor 105, the error amplifier 114 into which a load electrical-potential-difference detection value is inputted, and this error amplifier 114, The comparator 118 into which the output voltage and reference voltage Vr of a transistor 117,122 and a transistor 117 which drive the resistance 125 used as the load of a transistor 116 and this transistor 116 connected to this comparator 121 and resistance 124,125 are inputted, It has the transistor 120 which drives to the latch circuit 119 and this latch circuit 119 which were connected to this comparator 118, and controls the input stage of the output transistor 102, and the oscillator 126 which outputs an oscillation frequency to a comparator 101, and is constituted.
[0005] In drawing 8 , the output transistor 102 operates with the output voltage VD of a comparator 101, and a transistor 105,106 operates with actuation of this output transistor 102. The main transistor 106 drives the primary winding of a converter 108 with the frequency outputted from a comparator 101, and makes a secondary winding generate the alternating voltage which carried out the pressure up. After being rectified by diode 109, smooth [of the output of this transducer 108] is carried out by the capacitor 110, and direct-current output voltage is outputted to an output terminal 111. The terminal voltage (Vout) of a capacitor 110 is taken out through the partial pressure circuit by resistance 112 and 113, turns into input voltage of one terminal of the error amplifier 114, and is compared with reference

voltage Verr. The output voltage VB by this comparison result turns into one input voltage of a comparator 101. A comparator 101 performs the comparison with the output VA of an oscillator 126, the output voltage VB of the error amplifier 114, and the terminal voltage VC of resistance 124, a transistor 102 drives and, finally the energization condition of a converter 108 is controlled by the pulse period by this comparison result. The secondary-winding output voltage of a converter 108 changes with control of this energization condition.

[0006] On the other hand, a transistor 116,122,117 drives and the terminal voltage VC of resistance 124 changes with the output voltage of a comparator 121. Change and reference voltage Vr of this terminal voltage VC are compared by the comparator 118, and output voltage occurs from a comparator 118 at the time of VC>Vr. This comparator output is latched by the latch circuit 119, and a transistor 120 is turned on with this latch output. Output voltage stops arising in a converter 108, as a result of setting the base electrical potential difference of the output transistor 102 to zero level and a transistor's 102,105,106 being un-flowing by ON of a transistor 120.

[0007] Drawing 9 shows actuation of each part of the power circuit of drawing 8 . In a comparator 101, the one among the output voltage VB of the error amplifier 114 and the terminal voltage VC of resistance 124 where any or an electrical potential difference is lower is compared with VA. At the time of starting, the output voltage Vout of an output terminal 111 is zero, and the electrical potential difference VE by which a partial pressure is carried out by resistance 112,113 is zero. The partial pressure electrical potential difference VE is compared with reference voltage Verr by the error amplifier 114. When the partial pressure electrical potential difference VE is zero, the output voltage VB of the error amplifier 114 is the maximum swing piece ****** to a forward side. Therefore, a comparator 101 compares output voltage VA and VC, and since the potential (terminal voltage VC) of a capacitor 115 rises after starting, charging gradually from zero, the pulse width of the output voltage VD of a comparator 101 also spreads gradually. Thereby, a soft start is started. As for a transistor 122,117, a capacitor 115 is charged, as a result of the output of a comparator 121 becoming high-level and a transistor's 116 flowing, since the output VB of the error amplifier 114 is over reference voltage Vi in the meantime. Before the terminal voltage VC of a capacitor 115 exceeds reference voltage Verr, the output voltage Vout of an output terminal 111 reaches a predetermined value, the input of the error amplifier 114 balances to VE**Verr, output voltage VB turns into below the reference voltage Vi, and a transistor 116 intercepts it. Here, the terminal voltage VC of a capacitor 115 is stabilized with the electrical potential difference decided by resistance 123,124.

[0008] If between output terminals 111 connects too hastily during operational stability of a power circuit, output voltage Vout will become zero. For this reason, the output voltage VB of the error amplifier 114 is shifted to a forward side, and exceeds reference voltage Vi. Consequently, a transistor 116 flows and a capacitor 115 is charged with a transistor 117. When the terminal voltage of a capacitor 115 exceeds reference voltage Verr, the output voltage of a comparator 118 is changed high-level, and this output voltage is latched to a latch circuit 119. Thereby, a transistor 120 flows and the output transistor 102 becomes off.

[0009] According to the power circuit shown in drawing 8 , there is the description that both the circuits of a soft start and short circuit protection can be formed by one capacitor 115. Moreover, in the process in which a protection network is operated, it can prevent that a protection network malfunctions by a short-time load short circuit, a short-time noise, etc. by establishing a time delay until a protection network operates.

[0010] Drawing 10 shows the 2nd example of a configuration of the conventional power circuit. This power circuit is inverter equipment for making a electric-discharge lamp turn on, and that detail is shown in JP,2-065100,A. This inverter equipment The resistance 205 connected to the switch 204 connected to the output side of the resistance 203 connected to the diode bridge 201 for power sources, the capacitor 202 for smooth connected to this output, and the detection power-source line PL 1, and this resistance 203, and this switch 204, The partial pressure electrical potential difference by the resistance 208,209 and resistance 208,209 which were connected with the anode of the capacitor 206 connected to the output side of resistance 203, the diode 207 connected to the outgoing end of the detection power-

source line PL 1, and this diode 207 between touch-down Rhine The electrical potential difference of the node of the transistor 210 considered as a base input, the resistance 211 connected with the anode of diode 207 between the collectors of a transistor 210, the resistance 213 connected with the collector of a transistor 210 between touch-down Rhine, and resistance 211 and 213 The transistor 214 considered as an input, The resistance 216,217,219 connected with the collector of a transistor 215 and this transistor 215 to which the base was connected at the node of the resistance 210,212 connected with the collector of this transistor 214 in Rhine of the detection power-source line PL 1, and these resistance between touch-down Rhine, The output voltage of resistance 215 The transistor 218 to which it considered as the base input and the emitter was connected at the node of resistance 217 and 219, The resistance 220 and diode 221 which were connected with the emitter of this transistor 218 between the outputs of a diode bridge 201 and resistance 222, the output of a diode bridge 201 and the capacitor 223 inserted in the serial between touch-down Rhine, and a transistor 227 And between diode 228, and the collector of a transistor 227 and the cathode of diode 228 The connected diode 229, the ballast transformer 232 by which the 3rd coil N3 was connected between Rhine of the detection power-source line PL, and touch-down Rhine, the diode 230 connected to the end of a coil N3, the capacitor 231 connected with the other end of a coil N3 between diodes 230, Between the collector of a transistor 227, and the output of a diode bridge 201 Between the connected capacitor 223, and the output of a diode bridge 201 and the 1st coil N1 of the ballast transformer 232 Between the connected coil 224 with a center tap, the base of a transistor 227, and the end of the 2nd coil N2 It has the capacitor 234 connected between the filaments of the capacitor 225 by which the series connection was carried out and a coil 226, the electric-discharge lamp 233 (TLP) as a load connected between the output of a diode bridge 201, and the other end of the 1st coil N1, and this electric-discharge lamp 233, and is constituted.

[0011] A switch 204 is modulated light SUITCHI, and if this switch 204 is turned on, parallel connection of the resistance 205 by which the series connection was carried out to this is carried out to resistance 208, the base electrical potential difference of a transistor 210 rises quickly, and a transistor 210 serves as ON, and it will be in the condition that the usual modulated light actuation is performed.

[0012] Drawing 11 shows change of the terminal voltage of the capacitor 206 of the power circuit of drawing 10 . Actuation of the power circuit of drawing 10 is explained using drawing 11 . AC power supply AC -- a diode bridge 201 and a capacitor 202 -- rectification -- and smooth is carried out. If power is applied to the 1st coil N1 of the ballast transformer 232 through a coil 224, feedback will be performed at the base of a transistor 227 through a coil 226 and a capacitor 225 from the 2nd coil N2 of the ballast transformer 232, and a transistor 227 will oscillate. Self-oscillation with a transistor 227 is started by this, the current of a predetermined period energizes continuously in the 1st coil N1, high-frequency voltage is continued and outputted among the both ends of the 1st coil N1+ coil 224, and preheat current is supplied to a electric-discharge lamp 233. The generated high-frequency voltage is taken out from the control winding N3 of the ballast transformer 232, and the electrical potential difference by which rectification smooth was carried out by diode 230 and the capacitor 231 is taken out through the detection power-source line PL 1, and it is supplied to the control circuit ******(ed) by the transistor 210,214,215,218.

[0013] Since the electrical potential difference which charges a capacitor 206 has not arisen at the beginning [of powering on], a transistor 214 is in an OFF state. Therefore, both the transistors 215,218 will be in an OFF state, and the base feedback resister of a transistor 227 will serve as high resistance by the serial of resistance 219,220, and a transistor 227 will be in the operating state depending on resistance 222. Consequently, a electric-discharge lamp 233 will be in a modulated light condition, and the preheating of a electric-discharge lamp 233 will be performed in this condition.

[0014] A capacitor 206 is gradually charged through resistance 203 as are shown in drawing 11 and time amount passes. And a transistor 214 will be turned on if the terminal voltage of a capacitor 206 rises in time amount t1 beyond a predetermined value. According to this, a transistor 215,218 is also turned on, the both ends of resistance 219 short-circuit it, and the base feedback resister of a transistor 227 becomes the low resistance of only resistance 220 mostly, and will be in a full drive condition. Therefore, the high voltage occurs in a coil N1, and a electric-discharge lamp 233 lights up.

[0015] Here, when a electric-discharge lamp 233 is in the terminal condition of the lighting engine performance and does not light up, load impedance becomes high, it will be in a light load condition, and output voltage (terminal voltage of a electric-discharge lamp 233) will rise gradually. In this condition, as shown in drawing 11 , even if the both-ends electrical potential difference of a capacitor 206 passes over time amount t2, it continues a rise. And after the predetermined time decided by the time constant which consists of resistance 203, a capacitor 206, resistance 208, and resistance 209 (time amount t3), a transistor 210 is turned on and both the transistors 214,215,218 are cut off. Thereby, a power circuit changes to modulated light mode, inverter output voltage is lowered, and each part of a circuit is protected from the high voltage. In addition, since the both-ends electrical potential difference of a capacitor 206 does not rise so much when a electric-discharge lamp 233 lights up normally, a transistor 210 is not turned on but an inverter circuit continues rated lighting of a electric-discharge lamp 233.

[0016] Drawing 12 shows the configuration of the conventional power circuit which used the piezoelectric transformer. This power circuit is an inverter which drives a cold cathode tube as a load, and that detail is shown in JP,10-052068,A. It also sets to the inverter using a piezoelectric transformer, and the protection network is prepared for the purpose of the exoergic reduction of degradation prevention of the property of a piezoelectric transformer, and passive circuit elements at the time of opening of a load.

[0017] This power circuit is equipped with the driver voltage control circuit 311 connected to the overvoltage protection circuit 310, the frequency control circuit 303, and the overvoltage protection circuit 310 which were connected to the piezoelectric transformer 301 to which the load 302 was connected, the frequency control circuit 303 connected to the load 302, the booster circuit 304 combined with the piezoelectric transformer 301, the load 302, and the frequency control circuit 303, and is constituted.

[0018] Drawing 13 shows the output characteristics of a piezoelectric transformer 301. A piezoelectric transformer 301 forms a primary lateral electrode and a secondary electrode in tabular piezo-electric ceramics, and is constituted. By impressing the alternating voltage of resonance frequency to a primary lateral electrode, output voltage occurs in a secondary electrode according to the piezo-electric effect. This piezoelectric transformer 301 has a high output impedance, and as shown in drawing 13 , when the impedance of a load is high, a pressure-up ratio becomes high, and it generates the high voltage, in order to depend for that actuation on load impedance. the piezoelectric transformer 301 of such a structure and a property -- electromagnetism -- there is an advantage which can attain miniaturization and thin shape-ization as compared with a transformer, and it is observed by applications, such as a back light power source of a liquid crystal display.

[0019] The frequency control circuit 303 The energization current of a load 302 The current potential conversion circuit 312 changed into an electrical-potential-difference value, and its output The integrator 315 which finds the integral based on the output voltage **** 2 of the rectifying rectifier circuit 313, the comparator 314 in comparison with reference voltage Vref, and the overvoltage protection circuit 310, the output voltage of a comparator 314, and the output voltage of a comparator 316, reference voltage Vmin, and the output voltage of an integrator 315 It has VCO (voltage controlled oscillator)317 which outputs control voltage Vr and Vvco based on the output voltage of the comparator 316 to compare and an integrator 315, and is constituted.

[0020] A booster circuit 304 is equipped with 2 phase drive circuits 309 which drive the 1st autotransformer 305, the 2nd autotransformer 306, the 1st switching transistor 307, the 2nd switching transistor 308, and the 1st and 2nd switching transistor 307,308, and is constituted. Two phase drive circuits 309 drive the 1st and 2nd switching transistor 307,308 based on the control voltage Vvco outputted from VCO317.

[0021] The overvoltage protection circuit 310 is equipped with the comparison block 320 which compares with the comparison electrical potential difference Vmax the output voltage of the partial pressure circuit 318 which pressures partially the output voltage of a piezoelectric transformer 301, the rectifier circuit 319 which rectifies the output voltage of this partial pressure circuit 318, and this

rectifier circuit 319, and is constituted.

[0022] Next, actuation of a booster circuit 304 is explained. The 1st switching transistor 307 and 2nd switching transistor 308 are turned on by turns with the clock of the opposition outputted from 2 phase drive circuits 309. Thereby, a power source is supplied to the upstream of the 1st and 2nd autotransformer 305,306 from a power source VDD, and it charges as current energy. If the 1st and 2nd switching transistor 307,308 is turned off by turns, the 1st and 2nd autotransformer 305,306 will emit charge energy, respectively. With a piezoelectric transformer 301, the equivalence input capacitance of a load 302, the upstream inductance of an autotransformer, and the inductance of the sum total of a secondary inductance, this charge energy is changed into a voltage resonance wave, and is impressed to the primary lateral electrode of a piezoelectric transformer 301.

[0023] Next, actuation of the frequency control circuit 303 is explained. The load current Io of a load 302 is changed into an electrical-potential-difference value by the current potential conversion circuit 312, and is further changed into direct current voltage in a rectifier circuit 313. This direct current voltage is compared with reference voltage Vref by the comparator 314. When direct current voltage is small, a comparator 314 outputs a signal which goes up at a rate that the output of an integrator 315 is fixed to an integrator 315. The signal outputted from the integrator 315 is inputted into VCO317. VCO317 outputs the frequency pulse in inverse proportion to the inputted electrical-potential-difference value, and when a transistor 307,308 drives on the frequency of 1/the 2, a piezoelectric transformer 301 drives it. Therefore, when the load current Io is smaller than a predetermined value, the drive frequency of a piezoelectric transformer 301 continues a fall.

[0024] The pressure-up ratio of a piezoelectric transformer 301 increases, and the load current Io increases in time as drive frequency f approaches resonance frequency fr, since the piezoelectric transformer 301 is set up so that drive frequency f1 may be made into the starting point and it may become low as shown in drawing 13 . Drive frequency f continues a fall, and when the electrical potential difference inputted into a comparator 314 in the drive frequency f0 shown in drawing 13 becomes larger than reference voltage Vref, as for a comparator 314, an output signal is generated so that the output of an integrator 315 may remain holding the last output value. Thereby, the output frequency of VC0317 becomes fixed, and a piezoelectric transformer 301 drives on the fixed frequency f0, and becomes fixed [the load current Io].

[0025] If the load current Io is changed and the input voltage of a comparator 314 becomes smaller than reference voltage Vref by impedance fluctuation of a load 302 etc. after a piezoelectric transformer 301 begins to drive by constant frequency, piezoelectric transformer 301 drive frequency will begin a fall again. In the condition that comparator 314 input voltage does not become larger than reference voltage Vref, if the drive frequency of a piezoelectric transformer 301 continues falling, drive frequency will amount to f2 shown in drawing 13 . If drive frequency f2 is reached, since the output voltage Vint of an integrator 315 becomes higher than reference voltage Vmin, the input (output of an integrator 315) of a comparator 316 will output a reset signal Vr to an integrator 315. If an integrator 315 is reset, the output voltage Vs will become min. Consequently, the output of VCO317 becomes the highest frequency and a piezoelectric transformer 301 is driven by drive frequency f1. From this condition, the drive frequency of a piezoelectric transformer 301 begins to fall again. If the frequency which the input voltage of a comparator 314 becomes more than reference voltage Vref is found in process of this actuation, the output voltage of an integrator 315 will be locked and the output frequency of VCO317 will become fixed.

[0026] Two phase drive circuits 309 generate the output voltage Vg1 and Vg2 from which a phase differs. Two phase drive circuits 309 repeat reversal of output voltage Vg1 and Vg2, whenever Vvco is inputted from the frequency control circuit 303. In the driver voltage control circuit 311, when the drain electrical potential difference Vd1 of the 1st switching transistor 307 is inputted and the value of this drain electrical potential difference Vd1 has exceeded rather than the predetermined value, time sharing of the input from a power source VDD is carried out to the 1st autotransformer 305 and 2nd autotransformer 306, and it is outputted to them, and it controls so that the drain electrical potential difference Vd1 does not exceed a predetermined value. The frequency of this time-sharing output is

determined by Vvco from VC0317. Thereby, even if it changes a power source VDD, it becomes possible to maintain high power conversion effectiveness as an inverter.
[0027] Since load impedance is high, when the pressure-up ratio of a piezoelectric transformer 301 becomes high and the piezoelectric transformer output voltage Vo becomes large, the overvoltage protection circuit 310 is formed in order that a piezoelectric transformer 301 may prevent carrying out the autoclasis by fault vibration. The piezoelectric transformer output voltage Vo outputted from the secondary electrode of a piezoelectric transformer 301 is impressed to the partial pressure circuit 318. After the output voltage of the partial pressure circuit 318 is changed into direct current voltage Vr by the rectifier circuit 319, it is inputted into the comparison block 320. The comparison block 320 outputs two output signals ****1 (signal which resets an integrator 315), and ****2 (signal which changes the upper limit of the output frequency of VC0317), when reference voltage Vmax is compared with the output voltage of a rectifier circuit 319 and it is in the condition of Vr>Vmax. ****1 is a signal outputted only while input voltage is larger than reference voltage Vmax, and ****2 is a signal with which only a certain time amount (time amount taken for the output of an integrator 315 to change from the minimum electrical potential difference to a maximum voltage) continues an output, when input voltage becomes larger than reference voltage Vmax.
[0028] Drawing 14 shows actuation of each part of the power circuit of drawing 12 . In drawing 14 , the drive frequency of a piezoelectric transformer 301 and the relation between the piezoelectric transformer output voltage Vo and output signals ****1 and ****2 are shown. The output of an integrator 315 will become the minimum electrical potential difference, if an output signal **** 1 is inputted. therefore, if the division ratio of the partial pressure circuit 318 becomes large more than this, the output voltage Vo of the level of causing property degradation of a piezoelectric transformer 301 will become equal to the reference voltage Vmax after passage about a rectifier circuit 319 (Vo=Vmax) -- it sets up like.
[0029] In the case of the cold cathode tube with which a load 302 is used for the back light of LCD for notebook computers, generally, the rated output of the piezoelectric transformer 301 used for this is about 4W. In such a piezoelectric transformer 301, it becomes the value which can prevent property degradation if the maximum of the output voltage Vo is set as about 1500V-2000V, and exceeds the lighting starting potential of a cold cathode tube (load 302). In drawing 13 , the frequency to which the output voltage of a rectifier circuit 319 becomes larger than reference voltage Vmax is f3. Although the output signal **** 2 is usually made into the frequency f1 which shows the upper limit of the drive frequency of a piezoelectric transformer 301 to drawing 13 , the period when output voltage **** 2 is inputted into VC0317 changes to f4 of a frequency upper limit.
[0030] Smaller [the output voltage Vo of a piezoelectric transformer 301] than a predetermined value, when the load current Io is smaller than a predetermined value, the drive frequency of a piezoelectric transformer 301 carries out the sweep of between f2 from the frequency f1 in drawing 13 . Moreover, more greatly [the output voltage Vo of a piezoelectric transformer 301] than a predetermined value, when the load current Io is smaller than a predetermined value, the drive frequency of a piezoelectric transformer 301 carries out the sweep of between f3 from the frequency f4 of drawing 13 . Here, it is the case where the output voltage Vo of a piezoelectric transformer 301 becomes [Current Ic] smaller than a predetermined value more greatly than a predetermined value, at the load opening time by open circuit of a path cord. Since the output voltage Vo of a piezoelectric transformer 301 becomes large at the time of load opening since load impedance is large, and connection of a load 302 is severed, the load current Io is zero. Since possibility that connection of a load 302 will return is continued few and the load current Io does not reach a predetermined value, this condition continues the sweep of the drive frequency of a piezoelectric transformer 301.
[0031] The resonance wave which drives a piezoelectric transformer 301 sets up the inductance of an autotransformer 305,306 so that zero switching may become the optimal on the frequency f0 of drawing 13 , and it is made to become the sine wave of a half wave. Thereby, power conversion effectiveness as an inverter is made to best.
[0032] In the configuration of drawing 12 , more greatly [the output voltage Vo of a piezoelectric transformer 301] than a predetermined value, when the load current Io is smaller than a predetermined

value (at namely, the time of load opening), the drive frequency sweep of a piezoelectric transformer 301 will continue a long period of time or eternally. Then, in drawing 13 , the frequency f1 which was the upper limit of the frequency-sweep range is switched to f4. By this treatment, collapse of the zero switching of a resonance wave in an autotransformer 305,306 decreases, and generation of heat of components can be reduced.

[0033] By the way, in the inverter which uses a cold cathode tube as a load, when abnormalities are detected at the time of the injection of a power source VDD, a conflicting requirement is in time amount until an overvoltage protection circuit starts actuation. After making the 1st [the] continue an inverter output at least 5 to 6 seconds or more after powering on, it is the demand which makes an output intercept. Moreover, it is the demand which the 2nd is made to suspend the circuit actuation which drives a piezoelectric transformer 301 after powering on (for example, the instant for about 0.1 seconds), and intercepts an output. The reason is explained below.

[0034] First, the reason of said 1st demand is explained. In the case of low temperature etc., a use ambient atmosphere may require the time amount for about 1 second by lighting from impression initiation of the electrical potential difference to a load (cold cathode tube). Under such an environment, since the impedance before lighting initiation of a cold cathode tube is high, by the time it falls an electrical potential difference to the impedance value which can start lighting after impression initiation, time amount longer than usual will be needed. Therefore, after powering on, after the condition of a cold cathode tube of not switching on the light continues 5 to 6 seconds or more, it is necessary to set up, in order to guarantee lighting of a cold cathode tube also at low temperature so that cutoff actuation of a protection network may be started. When it is in the situation which a cold cathode tube turns on after inverter powering on and 1 second temporarily and is made a setup by which actuation is intercepted after inverter powering on and 0.5 seconds, originally, although the cold cathode tube should light up after [of inverter powering on] 1 second, a cutoff circuit operates before that, the circuit which drives a piezoelectric transformer 301 stops, and the fault that a cold cathode tube is un-switching on the light arises. In addition, recently, for improvement in safety, at the time of un-switching [of a cold cathode tube] on the light, as shown in JP,02-065100,A, a mode of operation is not changed but the demand which stops an inverter circuit completely is increasing.

[0035] Next, the reason of said 2nd demand is explained. At the time of abnormalities which are represented by opening short trial, there is a case where booster circuit components fume before fusing of a fuse. Opening or when it becomes short and the switching operation of a switching transistor stops, in a booster circuit, the coil and switching transistor from which this cause constitutes a booster circuit flow, and, thereby, a bigger current than always [forward] produces emitting smoke etc. Generally, the fuse is selected so that it may become 80% or less of fuse rated value about the passage current value of forward always. Therefore, hits may not be carried out even if a larger current than always [forward] passes in an instant. In such a case, emitting smoke etc. may be first produced on the components of a booster circuit rather than a fuse melts. However, generating of such a situation is not allowed on insurance. For this reason, when abnormalities are detected to a power up, it is necessary to stop the circuit which drives a piezoelectric transformer 301 within a certain time amount (for example, 0.1 seconds). The 1st and 2nd demand described above is a conflicting requirement to the time amount to initiation of a cutoff circuit of operation. However, both are indispensable demands in order to operate the power circuit using a piezoelectric transformer.

[0036]

[Problem(s) to be Solved by the Invention] However, according to the conventional power circuit, there is a problem described below.

(1) The distinction cannot be performed, although actuation may have to be immediately suspended with the time of continuing actuation of a piezoelectric transformer when too little [the load current]. For example, when in the case of JP,10-052068,A one actuation of the 1st or 2nd switching transistor (307,308) stops by the piezoelectric transformer driving means while turning on the cold cathode tube, a piezoelectric transformer continues output actuation by the switching transistor of the direction which is operating with the condition that output voltage does not reach a predetermined value.

[0037] Drawing 15 shows the wave of each part in case one side of a switching transistor is non-actuation. (a) of drawing 15 shows the drive frequency of a piezoelectric transformer 301, and since the load current Io has not reached a predetermined value, it is carrying out the sweep here on the frequencies f1-f2 shown in drawing 13 . (b) of drawing 15 shows the load current Io. In case drive frequency passes through near the resonance frequency fr of a piezoelectric transformer 301, a momentarily big value produces the load current Io. (c) of drawing 15 shows the output voltage Vo of a piezoelectric transformer 301. Since the impedance of a cold cathode tube is falling to a lighting possible value, actual value is low more slightly than the output voltage at the time of normal lighting.
[0038] However, since it does not have a difference remarkable in between at the time of normal lighting and the fault of a booster circuit when observing output voltage Vo, since the power circuit of JP,10-052068,A is the configuration of supervising only one output state and detecting abnormalities, both are undistinguishable. For this reason, the circuit which drives a piezoelectric transformer at the time of normal lighting cannot be stopped, a piezoelectric transformer will continue being driven also at the time of the fault of a booster circuit, and there is a possibility of damaging the components of a booster circuit.
[0039] Although the actual value of the load current Io at the time of the fault of a booster circuit is close to zero as shown in (b) of drawing 15 , the distinction with the case where normal lighting is being carried out also at the time of load opening since the load current Io is zero is possible. However, distinction of the case where you want to stop the drive of a piezoelectric transformer 301 like [at the time of the fault of a booster circuit] in an instant (for example, after 0.1 seconds), and the case where he wants to make an output continued for several [at least] seconds like [at the time of load opening] cannot be performed.
[0040] (2) It is being unable to change the time constant of the timer circuit to a halt of a drive circuit, or the change of a mode of operation. The power circuit (inverter) of each of said official report is a configuration which changes a halt or mode of operation of a drive circuit after specific time amount progress with a single time constant irrespective of the cause of abnormalities, when abnormalities are detected. For this reason, suitable control according to an abnormal condition or operating state cannot be performed.
[0041] (3) It is that the correspondence to the demand of an output halt for insurance and power-saving in that case are imperfect. In the configuration of having been shown in JP,2-065100,A and JP,10-052068,A, it has switchable composition in the mode of operation, but an output is not intercepted. When the demand about insurance increases and un-switching on the light and load opening of a cold cathode tube are detected in recent years, there are many demands which intercept an output. Moreover, although it has composition which intercepts an output in JP,2-065100,A, OSC, various kinds of comparators, and a halt of actuation of a transistor are omitted, for example. Although to intercept the electric power supply from the field of power-saving to each electronic parts which are not functioning is desired when not functioning as a circuit, while an output is intercepted, it does not correspond with the conventional technique.
[0042] Therefore, the purpose of this invention distinguishes exactly the stable waiting state of abnormality actuation of an output system, and a load, and is to offer the power circuit which enables it to perform current supply to the suitable protected operation and the suitable load according to each.
[0043]
[Means for Solving the Problem] In order that this invention may attain the above-mentioned purpose, as the 1st description, it carries out the pressure up of the driver voltage in a booster circuit, and inputs it into a primary piezoelectric transformer side. In the power circuit which drives the load which has the large impedance of temperature dependence with the output voltage of the secondary of said piezoelectric transformer level predetermined in the load current which flows said load -- smallness -- the time -- a too little current signal -- outputting -- too little, when said too little current signal is outputted, a current detection means and It has the means for stopping which stops actuation of said booster circuit, and a delay means to set up the time delay according to the level of said output voltage. Said means for stopping When said time delay passes, the power circuit characterized by determining

activation and the nonfulfilment of said actuation based on the existence of said too little current signal is offered.

[0044] According to this configuration, the cause which invites a malfunction to the booster circuit which drives a piezoelectric transformer is a time of a cause being in the booster circuit itself, when unloaded condition and a load are in a high impedance condition. Then, unloaded condition is judged from the load current, and the malfunction of a booster circuit is judged from the output voltage of a piezoelectric transformer. Halt actuation of a booster circuit is controlled based on these judgment results. When the malfunction of a booster circuit is judged, in order to specifically prevent generating of emitting smoke etc., when a booster circuit is stopped immediately and only unloaded condition (high impedance condition) is judged, it considers that it is in the condition before a load is fallen and attached to a steady state, and postponement time amount until it stops a booster circuit is set up comparatively long. Thereby, if a halt of a driving means of operation can be appropriately performed to abnormality actuation of a booster circuit etc. and also it is the load (for example, cold cathode tube) from which load impedance tends to change, the lighting guarantee at the time of low temperature will be attained.

[0045] Moreover, in order that this invention may attain the above-mentioned purpose, as the 2nd description, it carries out the pressure up of the driver voltage in a booster circuit, and inputs it into a primary piezoelectric transformer side. In the power circuit which drives the load which has the impedance which has temperature dependence with the output voltage of the secondary of said piezoelectric transformer level predetermined in the load current which flows said load -- smallness -- the time -- a too little current signal -- outputting -- too little, when said too little current signal is outputted, a current detection means and It has the means for stopping which stops actuation of said booster circuit, and a delay means to set up the time delay according to the level of said output voltage. Said means for stopping When the time check of said time delay is completed, said actuation is performed, when the time check of said time delay is interrupted on the way, it is characterized by determining the nonfulfilment of said actuation, and power circuit offer is made.

[0046] According to this configuration, the condition of a load is judged by supervising the load current with a too little current detection means, and also detection of the fault of a piezoelectric transformer is judged based on the output voltage of a piezoelectric transformer by the means for stopping, it grasps whether based on these results, abnormalities have arisen in the circuit, and whether abnormalities are in a load, and the timing which stops actuation of a booster circuit is determined. Thereby, if a halt of a driving means of operation can be appropriately performed to abnormality actuation of a booster circuit etc. and also it is the load (for example, cold cathode tube) from which load impedance tends to change, the lighting guarantee at the time of low temperature will be attained.

[0047]

[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained based on a drawing. Drawing 1 shows the power circuit by this invention. The power circuit of this invention is equipped with the driver voltage control circuit 311 and the cutoff section 400 which were connected to the overvoltage protection circuit 310, the frequency control circuit 303, and the overvoltage protection circuit 310 which were connected to the piezoelectric transformer 301 to which the load 302 was connected, the frequency control circuit 303 connected to the load 302, the booster circuit 304 connected to the piezoelectric transformer 301, the load 302, and the frequency control circuit 303, and is constituted. Fu is the fuse of a power source among drawing. Circuits other than cutoff section 400 have the same configuration as the power circuit shown in drawing 15 , or the same function. Therefore, the explanation which overlaps below is omitted.

[0048] The cutoff section 400 is equipped with the delay circuit 402 which outputs the delay signal Vad based on the output signal Vmin of the too little current detector 401 which makes the load current Io an input signal, and this too little current detector 401, and the output voltage **** 2 of the overvoltage protection circuit 310, and the cutoff circuit 403 which outputs an output signal Voff based on the delay signal Vad, and is constituted. The too little current detector 401 is equipped with the comparator 405 which compares the output voltage and reference voltage Vs of the rectifier circuit 404 which rectifies a load current (Io) detection value, and this rectifier circuit 404, and is constituted.

[0049] In the above configuration, the load current Io from a load 302 is inputted into the too little current detector 401. The too little current detector 401 compares the rectification output voltage and reference voltage Vs which rectified and acquired the value which changed the load current Io into the electrical-potential-difference value in the rectifier circuit 404 by the comparator 405. When the rectification output voltage from a rectifier circuit 404 exceeds reference voltage Vs, a comparator 405 generates the output signal of a high level.
[0050] A delay circuit 402 operates, when the electrical potential difference of a low is inputted from the too little current detector 401, and it outputs the predetermined delay signal Vad to the cutoff circuit 403. Moreover, output voltage **** 2 is inputted into a delay circuit 402 from the overvoltage protection circuit 310. This output voltage **** 2 is outputted from the overvoltage protection circuit 310, when the output voltage of a piezoelectric transformer 301 is larger than a predetermined value. A delay circuit 402 is controlled by output voltage **** 2, and outputs two kinds of delay signals. That is, the delay signal Vad with which long time amount will pass by the time the cutoff circuit 403 makes cutoff actuation start when output voltage **** 2 is a high-level signal is outputted, and when output voltage **** 2 is a low level signal, a delay signal with which time amount until the cutoff circuit 403 makes cutoff actuation start becomes short is outputted.
[0051] The cutoff circuit 403 is a circuit which outputs the signal which stops the drive of a piezoelectric transformer 301, when it continues beyond a certain time amount from a delay circuit 402 and the delay signal Vad continues being inputted. The generating time amount of the delay signal Vad outputted from a delay circuit 402 is long while output voltage **** 2 is inputted into the delay circuit 402 with a high level, and while output voltage **** 2 is inputted into the delay circuit 402 by the low, it becomes short. About the concrete numeric value of this long time amount and short time amount, it mentions later. The purpose of the cutoff circuit 403 is to prevent that circuit destructive prevention and the high voltage of a power source continue, and are outputted, when abnormalities occur for the load which is the electric power supply point of the case where abnormalities occur inside the circuit which constitutes a power source, or a power source.
[0052] In addition, in drawing 1 , although it was made the configuration which impresses the output signal of the cutoff circuit 403 to the driver voltage control circuit 311, as long as it is the circuit which can stop the drive of a piezoelectric transformer 301, you may be other circuits other than driver voltage control circuit 311.
[0053] Drawing 2 - drawing 5 show the timing of the drive circuit of drawing 1 of operation. Drawing 2 is a timing chart which shows actuation when a power circuit starts normally in ordinary temperature. (a) of drawing 2 is ON signal for starting the drive of a piezoelectric transformer 301. When a control circuit besides substitution by the power source VDD is IC-ized, substitution by the start signal of IC of operation is also possible for this ON signal. By the injection of ON signal, the output voltage Vo of a piezoelectric transformer 301 begins to rise, and the time amount A of drawing 2 is reached very much at the ignition starting potential of a load 302 (cathode-ray tube). The load current Io begins to increase from this time amount A, and output voltage Vo decreases conversely for the negative-impedance property of a load 302.
[0054] The reason the load current Io increases after the reason output voltage Vo rises after the injection of ON signal, and output voltage Vo reach cold cathode tube lighting starting potential is for carrying out the sweep of the drive frequency of a piezoelectric transformer 301 to the number side of low frequency from a high-frequency side. In order that there may be no load current Io immediately after ON signal injection, the output voltage of a comparator 405 is set to a low, and a delay circuit 405 outputs a delay signal to the cutoff circuit 403. Moreover, when output voltage Vo exceeds a predetermined value, output voltage **** 2 is inputted from the overvoltage protection circuit 310 to the timing shown in (e) of drawing 2 .
[0055] In the time amount B of drawing 2 , since the load current Io reaches a predetermined value, the output of a comparator 405 is set to a high level, and the delay signal Vad from a delay circuit 402 is set to a low. At this time, output voltage **** 2 is a low. The period when the delay signal Vad was outputted from the delay circuit 402 is shorter than time amount required when output voltage **** 2 is

a low, in order to make the cutoff circuit 403 generate a cutoff signal. Therefore, the cutoff circuit 403 does not carry out cutoff actuation.

[0056] Drawing 3 shows the actuation under the low-temperature environment of the power circuit of this invention. When a use ambient atmosphere is low temperature, as for a load 302 (cold cathode tube), an impedance becomes high rather than the time of ordinary temperature. Therefore, as shown in (b) of drawing 3 , output voltage Vo generates the long period high voltage, load impedance begins to fall gradually in the meantime, and a cold cathode tube starts lighting in time amount C soon. As shown in (e) of drawing 3 , as for the period of a high level, output voltage **** 2 (= overvoltage signal) is long compared with the time of ordinary temperature. The load current Io starts increase from time amount C. In time amount D, as the load current Io reaches a predetermined value and it is shown in (d) of drawing 3 , and the too little current signal Vmin changes to a low and shows coincidence at (f) of drawing 3 , the delay circuit signal Vad is set to a low. In this case, since [that output voltage **** 2 (overvoltage signal) is long] the period input was carried out, in order for the delay circuit signal Vad to make cutoff actuation perform in the cutoff circuit 403, the delay signal Vad needs to carry out a long period output for a high level. However, since the period which was maintaining a high level has the delay circuit signal Vad shorter than a predetermined period, the cutoff circuit 403 does not perform cutoff actuation.

[0057] Drawing 4 shows actuation of the power circuit at the time of no-load [which is represented by open circuit of the path cord to a load]. In this situation, in order that there may be no load, it becomes the same as the time when load impedance is very high, and as shown in (b) of drawing 4 , output voltage Vo continues the output of the high voltage. Moreover, in order that there may be no load, the load current Io does not flow. Therefore, as shown in (d) of drawing 4 , the too little current signal Vmin continues a high level after the injection of ON signal. As shown in (e) of drawing 4 , output voltage **** 2 (overvoltage signal) continues a high level. Consequently, output voltage **** 2 changes to a high level, and stops the drive of a piezoelectric transformer 301.

[0058] Drawing 5 shows actuation of a power circuit in case a booster circuit is fault. an electrical-potential-difference value with the output voltage Vo near (b) of drawing 2 of forward always shown in (b) of drawing 5 in this situation -- or there is completely nothing -- it is that either. The load current Io is **** 0 as shown in (c) of drawing 5 . Therefore, as shown in (d) of drawing 5 , it is whether as for the overvoltage signal **** 2 which the too little current signal Vmin maintains a high level, and is shown in (e) of drawing 5 , only few periods output a high level, or to continue a low. Since it is only few periods even when the overvoltage signal Vad is set to a high level, after only a comparatively short period maintains a high level, the delay circuit signal Vad starts cutoff actuation, as time amount F is shown in (g) of drawing 5 , and stops the drive of a piezoelectric transformer 301.

[0059] Drawing 6 shows the detail configuration of the drive circuit of drawing 1 . All or some of the frequency control circuit 303, overvoltage protection circuit 310, and driver voltage control circuit 311 are mounted in one IC package except for the adjustment constant. A delay circuit 402 is equipped with the capacitor 412 connected with the resistance 406a and 406b which forms a partial pressure circuit and the amplifier 406 which consists of transistor 406c, the resistance 407 used as the load of transistor 406c, the capacitor 408 connected with the collector of transistor 406c between touch-down Rhine, resistance 409 and the capacitor 410, the switch 411 connected to the collector of transistor 406c, and this switch 411 between touch-down Rhine, and is constituted. The resistance 413 connected to resistance 406a between the output terminal of a comparator 405 and the power source VDD is connected to the serial.

[0060] The cutoff circuit 403 is equipped with capacitor 403d by which parallel connection was carried out to the resistance 403b and 403c connected between the collectors of transistor 403a which operates with the output signal of a delay circuit 402, and a power source VDD and transistor 403a, and resistance 403c, and transistor 403e, and is constituted. A collector is connected to the base of transistor 403a, the base is connected to the collector of transistor 403a, and, as for transistor 403e, the emitter is connected at the node (minute pressure spot) of Resistance 403b and 403c. Moreover, a rectifier circuit 404 is equipped with capacitor 404b which carries out smooth [of the rectification output of diode 404a

which rectifies the output of a load 302, and this diode 404a], and load resistance 404c, and is constituted.

[0061] Although the circuit built in IC operates in response to an electric power supply from a power source VDD, when the electrical potential difference more than predetermined is not impressed to the ON/OFF terminal, it has the composition that the electric power supply from VDD is intercepted. This power source VDD is an electrical potential difference always impressed, when AC adapters (or battery pack etc.) are connected to the notebook computer etc. Moreover, an ON/OFF signal is impressed in connection with a notebook computer being power switched off.

[0062] a rectifier circuit 404 -- the load current Io -- rectification -- and it carries out smooth. A comparator 405 compares the output voltage and reference voltage Vs of a rectifier circuit 404, and when reference voltage Vs is small, it outputs the electrical potential difference of a high level to a delay circuit 402 through resistance 413. Transistor 406c in an amplifier 406 is turned on while the electrical potential difference of a high level is impressed to the base, and it slushes the current Is from the ON/OFF signal line 415 into touch-down Rhine. The input of another side of a delay circuit 402 is the output voltage **** 2 of the overvoltage protection circuit 310, and inputs this electrical potential difference into a switch 411. While there is an input beyond a predetermined value, between the terminal flows through a switch 411. A capacitor 412 is connected to the base of transistor 403a when this switch 411 is switch-on.

[0063] The cutoff circuit 403 transforms the current Is from the ON/OFF signal line 415 into the base electrical potential difference of transistor 403a. If a base electrical potential difference becomes higher than a predetermined value, transistor 403a will be turned on and will ground ON/OFF Rhine through resistance 414 and diode 403f. If transistor 403a is turned on, the ON state will be held and the flow of transistor 403a will once continue. If ON/OFF Rhine is grounded through transistor 403a, the electrical potential difference currently impressed to IC from the ON/OFF signal line 415 will fall. Consequently, supply of the power source VDD into IC is suspended, and the drive of a piezoelectric transformer 301 stops.

[0064] Next, actuation of the configuration of drawing 6 is explained. If the load current Io becomes small according to a certain cause when a power source VDD is supplied and ON signal is impressed to the ON/OFF signal line 415, the too little current detector 404, a delay circuit 402, and the cutoff circuit 403 will perform actuation explained below, will stop the drive of a piezoelectric transformer 301, and will intercept output voltage Vo.

[0065] When the load current Io is small, since it becomes lower [the electrical-potential-difference conversion value] than reference voltage Vs and the output of a comparator 19 is set to a low, transistor 406c becomes off. At this time, the current Is from ON / 0FF signal line 415 raises the base electrical potential difference of transistor 403a by the circuit which consists of resistance 407,409 and a capacitor 408,410. If, transistor 403a will be turned [the charge to a capacitor 408,410 progresses and the base electrical potential difference of transistor 403a comes to exceed a predetermined value] on. Thereby, the ON/OFF signal line 415 is grounded through the circuit which consists of resistance 414, diode 403f, and transistor 403a. Consequently, the electrical potential difference from the ON/OFF signal line 415 currently impressed to IC falls remarkably, supply of a power source VDD in the circuit in IC is intercepted, and, therefore, the drive of a piezoelectric transformer 310 is stopped. When the piezoelectric transformer 310 stopped the drive, the output of a piezoelectric transformer 301 disappears. In this case, the operating time until transistor 403a turns on from the injection of an ON/OFF signal is about 0.1 seconds, and the drive of a piezoelectric transformer 301 stops it to ON and coincidence of transistor 403a mostly.

[0066] The output voltage Vo of a piezoelectric transformer 301 is large, and it is in the condition that output voltage ****1 and VP2 is outputted from the overvoltage protection circuit 310, and actuation explained below when the electrical-potential-difference conversion value of the load current Io is smaller than reference voltage Vs since the load current Io is smaller than a predetermined value is performed, the drive of a piezoelectric transformer 301 is stopped, and an output is intercepted. SUITCHI 411 is turned on when the overvoltage protection circuit 310 outputs the output voltage ****

2 of a high level.
[0067] The frequency which drives a piezoelectric transformer 301 the moment the overvoltage protection circuit 310 detected the overvoltage of output voltage Vo and, on the other hand, outputted output voltage **** 1 is changed into f4 from the frequency f3 shown in drawing 13 , and a frequency falls from f4 to f3 again. However, output voltage **** 2 is continuing and outputting the high level which turns ON a switch 411 in the meantime. For this reason, when load impedance continues a high impedance equivalent, as for output voltage **** 2, maintaining a high level like at the time of load opening, for example is continued. The above relation is as having been shown in drawing 14 . While the sweep of the booster circuit 304 is carried out by the drive frequency f of a piezoelectric transformer 301, a switch 411 continues an ON state and a capacitor 412 is continuing being connected to the base of transistor 403a.
[0068] In addition, in the situation that the overvoltage protection circuit 310 outputs output voltage ****1 and ****2, and transistor 406c is un-flowing, it is important for the capacity value of a capacitor 412 to set up, as it has been 5 - 6 seconds, after an ON/OFF signal is supplied before transistor 403a turns on. Therefore, since the direction in case the output voltage **** 2 from the overvoltage protection circuit 310 is a high level becomes [the capacity value charged with Current Is] large, it transistor 403a States, and by the time - SU power surge becomes late and stops the drive of a piezoelectric transformer 301, long time amount will be needed.
[0069] By the above, the cutoff circuit 403 shown in drawing 6 operates by about 0.1 seconds and short time amount to actuation of a cutoff circuit at the time of the fault of a booster circuit 304, and after it spends 5 - 6 seconds, and long time amount at the time of load opening, the condition before load lighting, and un-switching on the light according to load characteristic degradation, it operates.
[0070] [Table 1] summarized actuation by the power circuit of this invention explained above.
[Table 1]

出力電圧Ｖｏ	負荷電流Ｉｏは 小さい又は無い	代表的な不具合原因
小さい又は無い	出力遮断迄約０．１秒 （０．０５～０．１５秒）	昇圧回路不具合（図１）
正常		昇圧回路不具合（図９）
大きい	出力遮断迄約５～６秒	負荷オープン、負荷点灯前、負荷不点灯

[0071] In [Table 1], although the time of detecting and intercepting late makes it 5 - 6 seconds for the time of load impedance of detecting booster circuit fault and intercepting early to be high in 0.1 seconds, this is the central value in the case of the combination of a common piezoelectric transformer inverter and a cold cathode tube, and can be changed according to the constant of a piezoelectric transformer inverter circuit, or the class of load.
[0072] For example, in the piezoelectric transformer inverter by the configuration of drawing 6 of the design by this invention person, when making the back light of 10.4 inch LCD for notebook computers turn on, in darkness with an ambient temperature [C] of 0 degree, they are 6 mses by back light lighting from powering on. Therefore, in the combination of this piezoelectric transformer inverter LCD, even if it sets the time amount which load impedance detects a high thing for 0.01 seconds, and the time of detecting the fault of a booster circuit and intercepting early intercepts late as 0.5 seconds, dark lighting

with an ambient temperature [C] of 0 degree can be guaranteed, and the emitting smoke ignition at the time of the fault of a booster circuit can be prevented, for example.

[0073] Drawing 7 shows the gestalt of other operations of the power circuit of this invention. The gestalt of the main configuration of this operation is the same as that of drawing 12 , is equipped with a piezoelectric transformer 301, the frequency control circuit 303, a booster circuit 304, 2 phase drive circuits 309, and the driver voltage control circuit 311, and it is constituted. And it replaces with the overvoltage protection circuit 310 of drawing 12 , and is made the configuration which formed the cutoff section 400 (it has the too little current detector 401, a delay circuit 402, the cutoff circuit 403, a rectifier circuit 404, and a comparator 405) shown in drawing 9 .

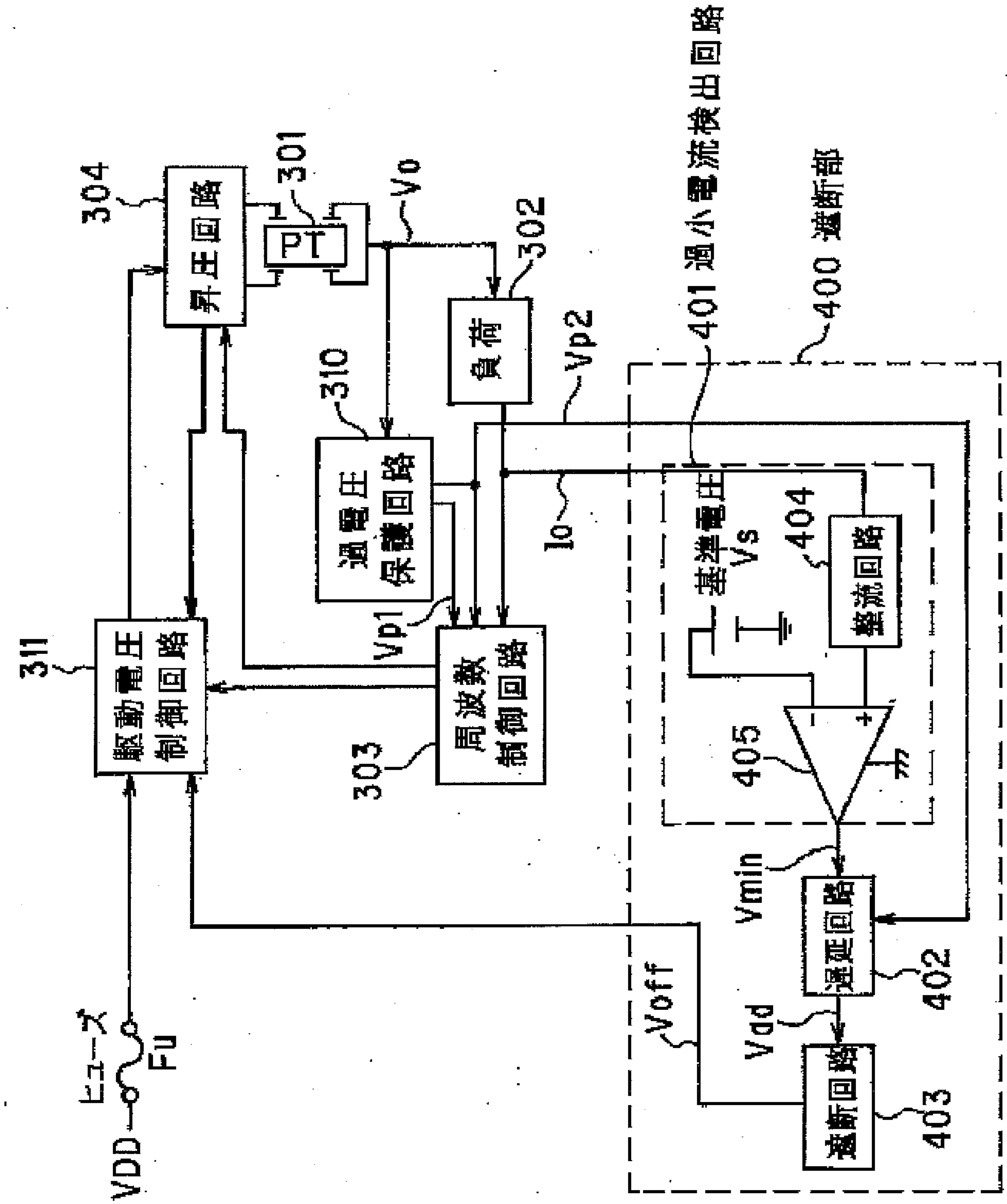
[0074] The 2nd autotransformer 306 and 2nd switching transistor 308 are deleted, the connection place of the output voltage Vg2 of 2 phase drive circuits 309 is lost, and the difference with the booster circuit 304 of the booster circuit 23 in drawing 7 , drawing 1 , and drawing 6 is opened in a booster circuit 23. In this booster circuit 23, when failure which the switching operation of a switching transistor 307 suspends occurs, a piezoelectric transformer 301 does not generate an output. Therefore, since transistor 406c of the too little current detector 401 becomes off since there is no load current Io in this failure, and there is also no output voltage Vo of a piezoelectric transformer 301, the output voltage **** 2 from the overvoltage protection circuit 310 is still a low, and does not flow through a switch 411. Thereby, an output intercepts in about 0.1 seconds after after an ON/OFF signal injection. This condition is equivalent to the condition that there is no load current Io of [Table 1], and there is also no electrical potential difference Vo, and different [that the value of Vo differs from the 1st example]. In addition, also in the gestalt of the 1st operation, when the fault the 1st switching transistor 307 and 2nd switching transistor 308 suspend [both] switching operation occurs, it is equivalent to the condition that there is no load current Io of [Table 1], and there is also no electrical potential difference Vo.

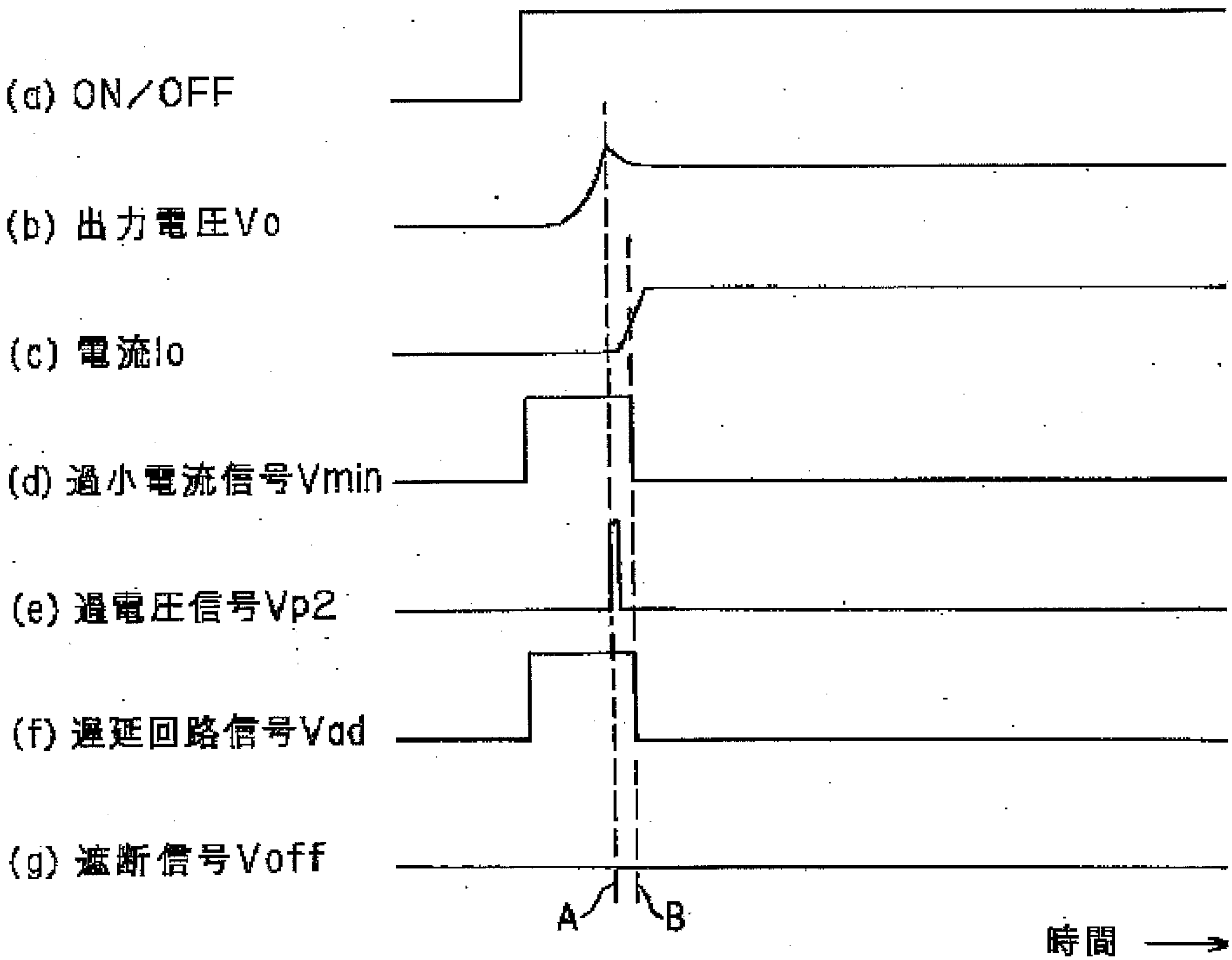
[0075]

[Effect of the Invention] Since the output state from a booster circuit to a piezoelectric transformer and impedance change of a load are detected, the time amount which enables a halt of a booster circuit of operation based on these is set up and it enabled it to stop actuation of a booster circuit based on this setup according to the power circuit of this invention as explained above, while being able to guarantee lighting actuation of a load when the load impedance at the time of low temperature etc. is high etc., the abnormalities of an output system including a booster circuit can be coped with. That is, although time amount was taken by after [electrical-potential-difference impression initiation] lighting since the impedance of the cold cathode tube before electrical-potential-difference impression was high when a perimeter environment was low temperature, it became possible by detecting output voltage and the load current to coincidence to distinguish abnormalities, such as a booster circuit.

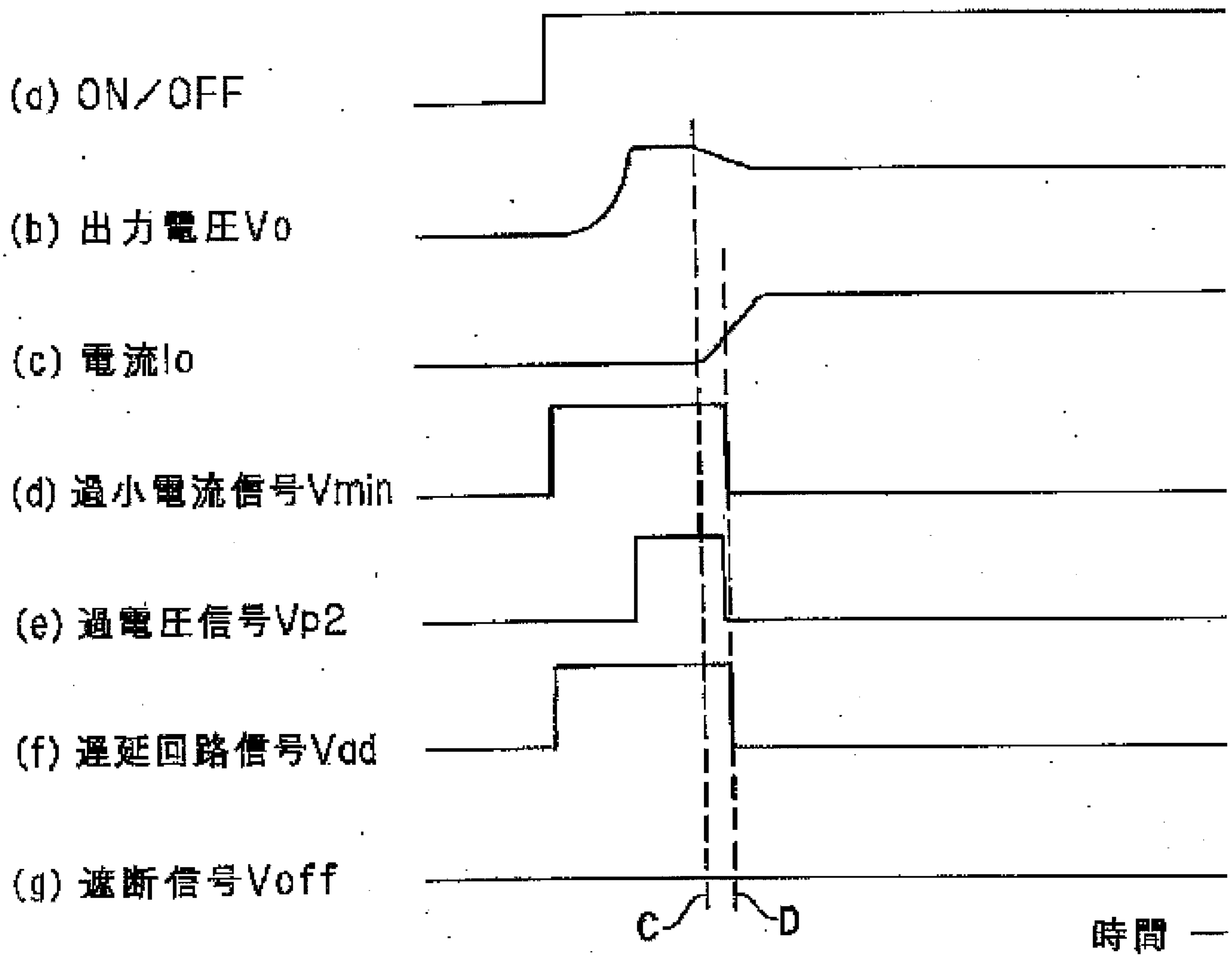
[0076] Moreover, when a cutoff circuit operates, and the ON/OFF electrical potential difference supplied to IC falls, the electric power supply from a power source VDD to each circuit in IC is stopped within IC. Therefore, power consumption in IC at the time of output cutoff is made to zero, and low-power-ization at the time of output cutoff can be attained.

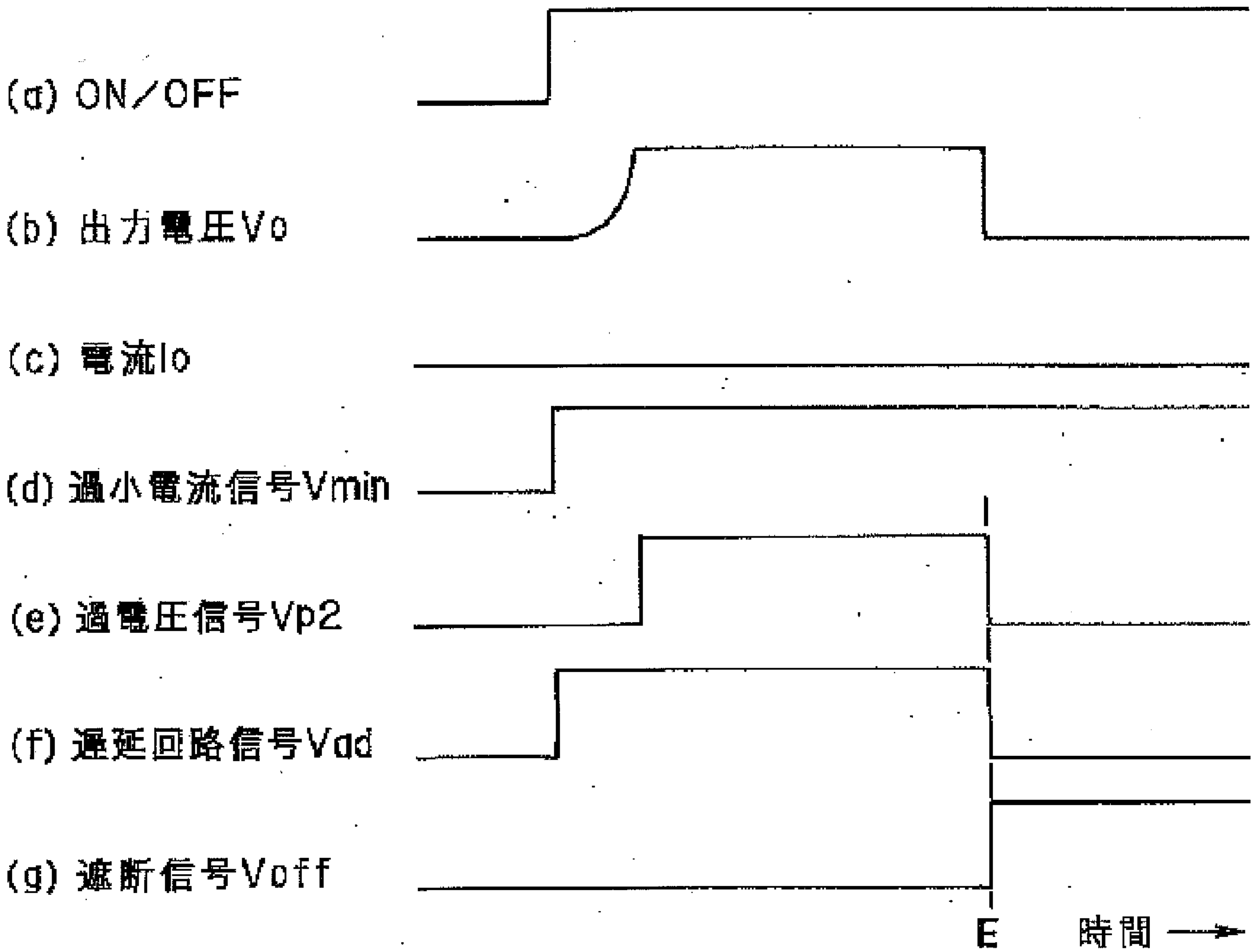
[Translation done.]

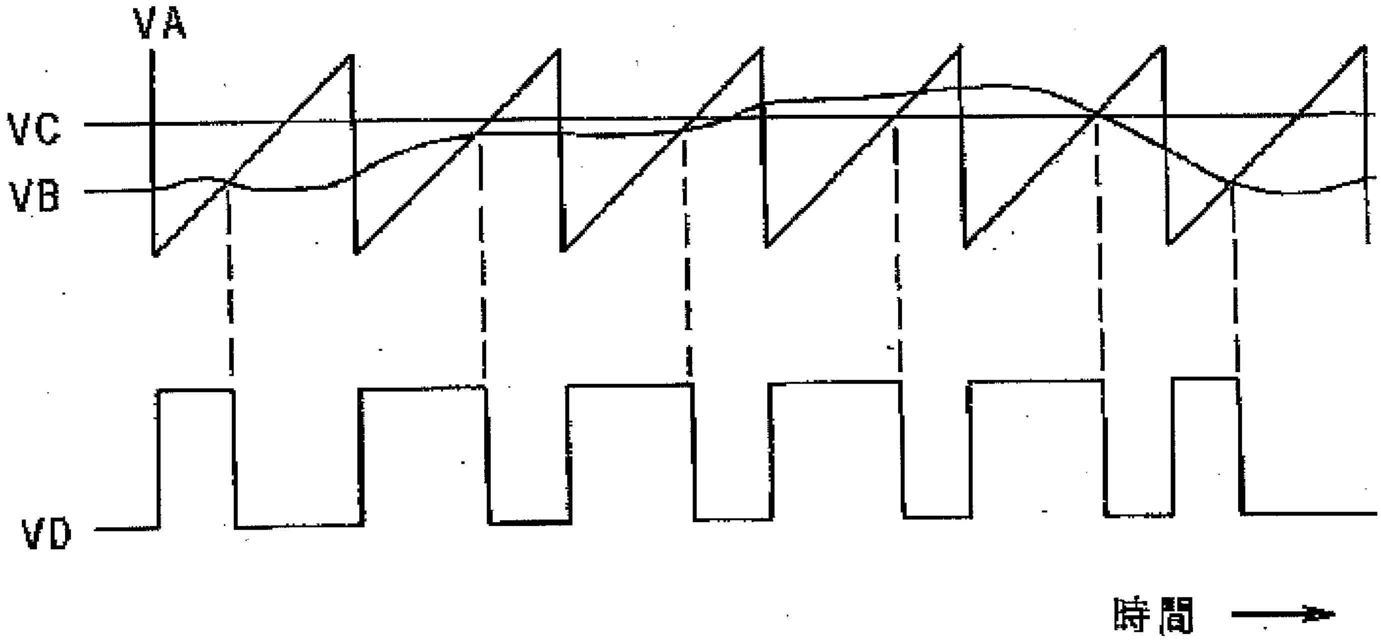

304
昇圧回路
301
PT
Vo
302
負荷
310
過電圧保護回路
Vp2
Vp1
Io
311
駆動電圧制御回路
303
周波数制御回路
401 過小電流検出回路
400 遮断部
基準電圧 Vs
404
整流回路
405
Vmin
遅延回路
402
Vdd
遮断回路
403
Voff
ヒューズ
Fu
VDD

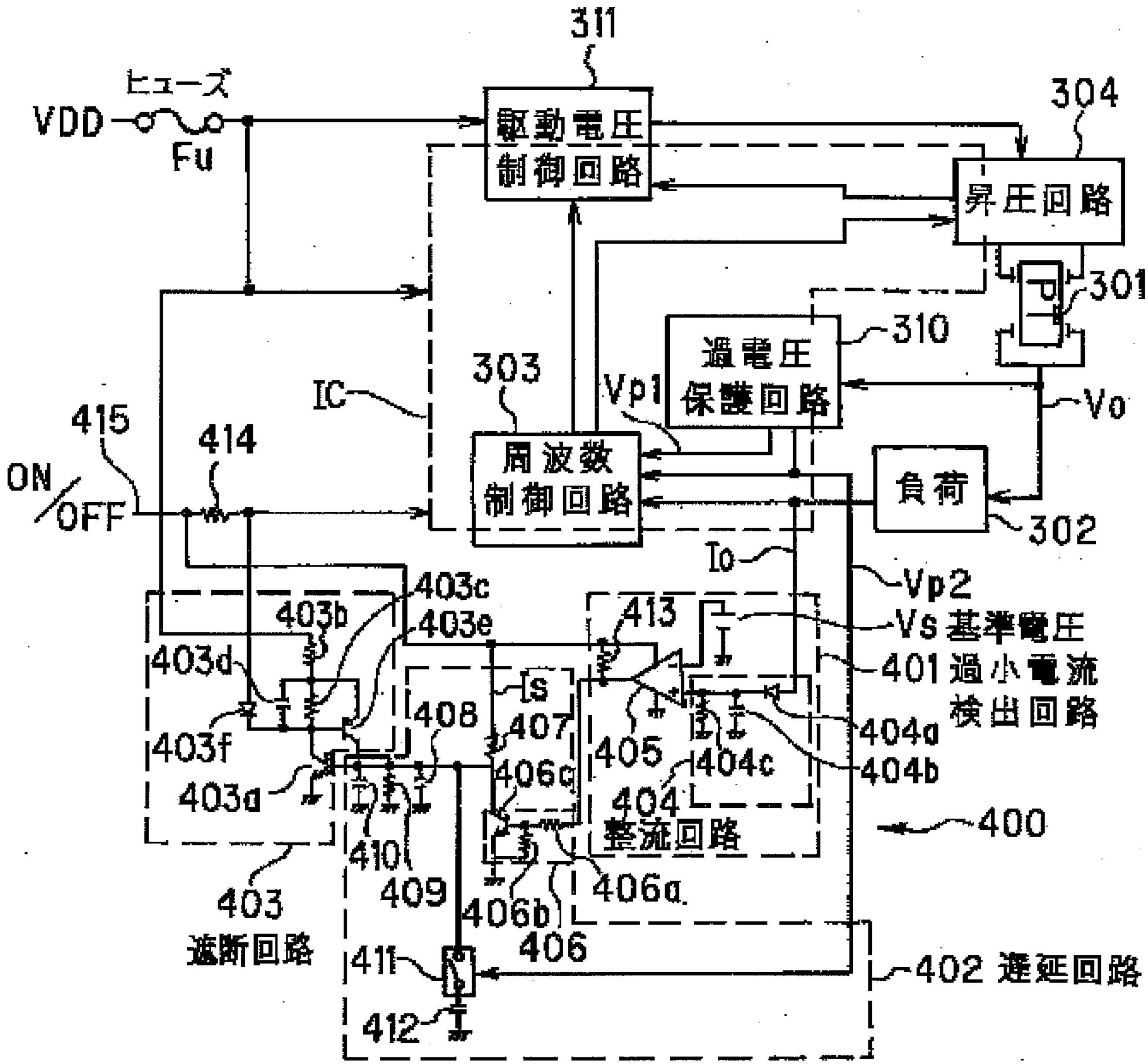


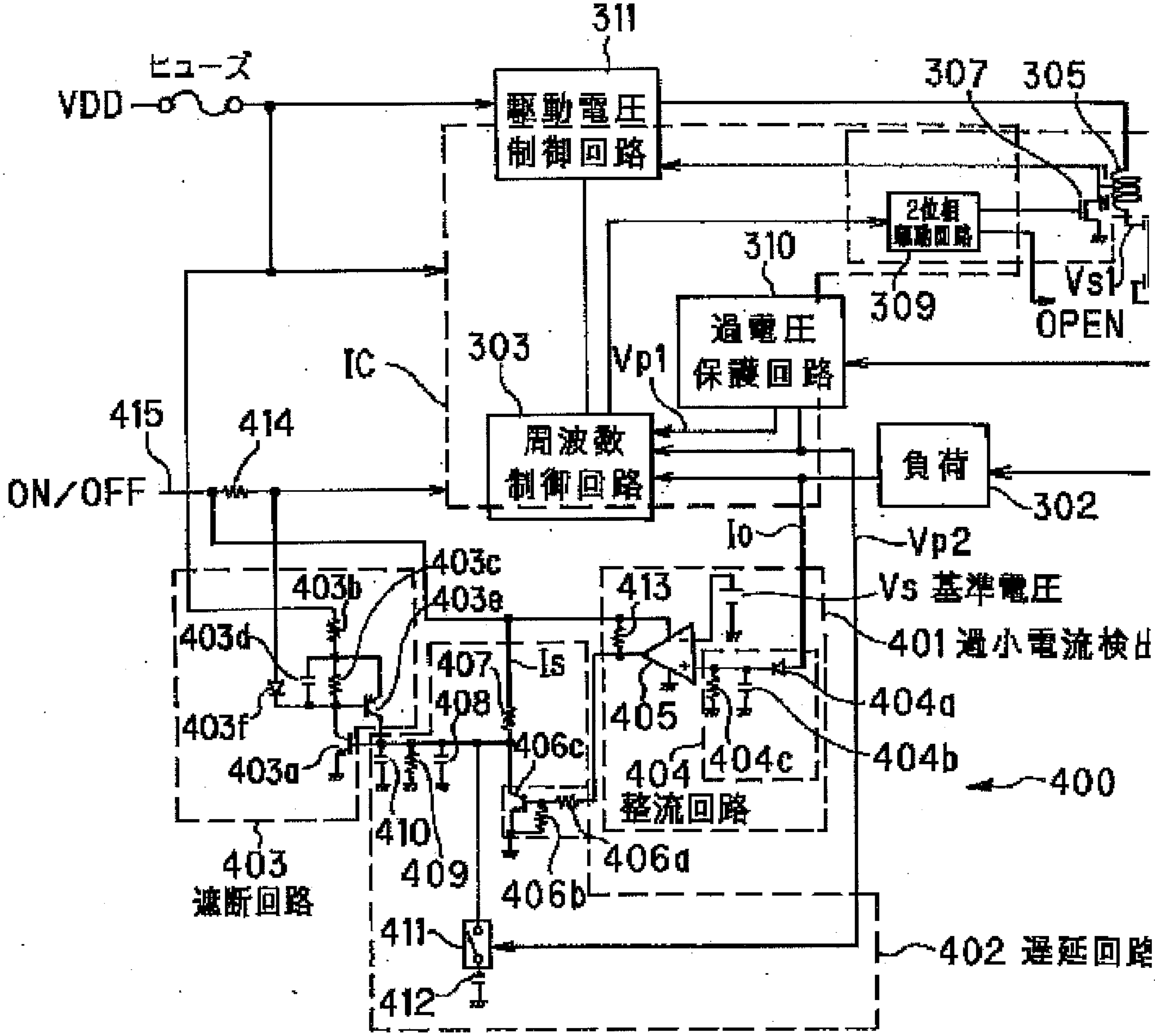
(a) ON／OFF
(b) 出力電圧Vo
(c) 電流Io
(d) 過小電流信号Vmin
(e) 過電圧信号Vp2
(f) 遅延回路信号Vad
(g) 遮断信号Voff
A
B
時間

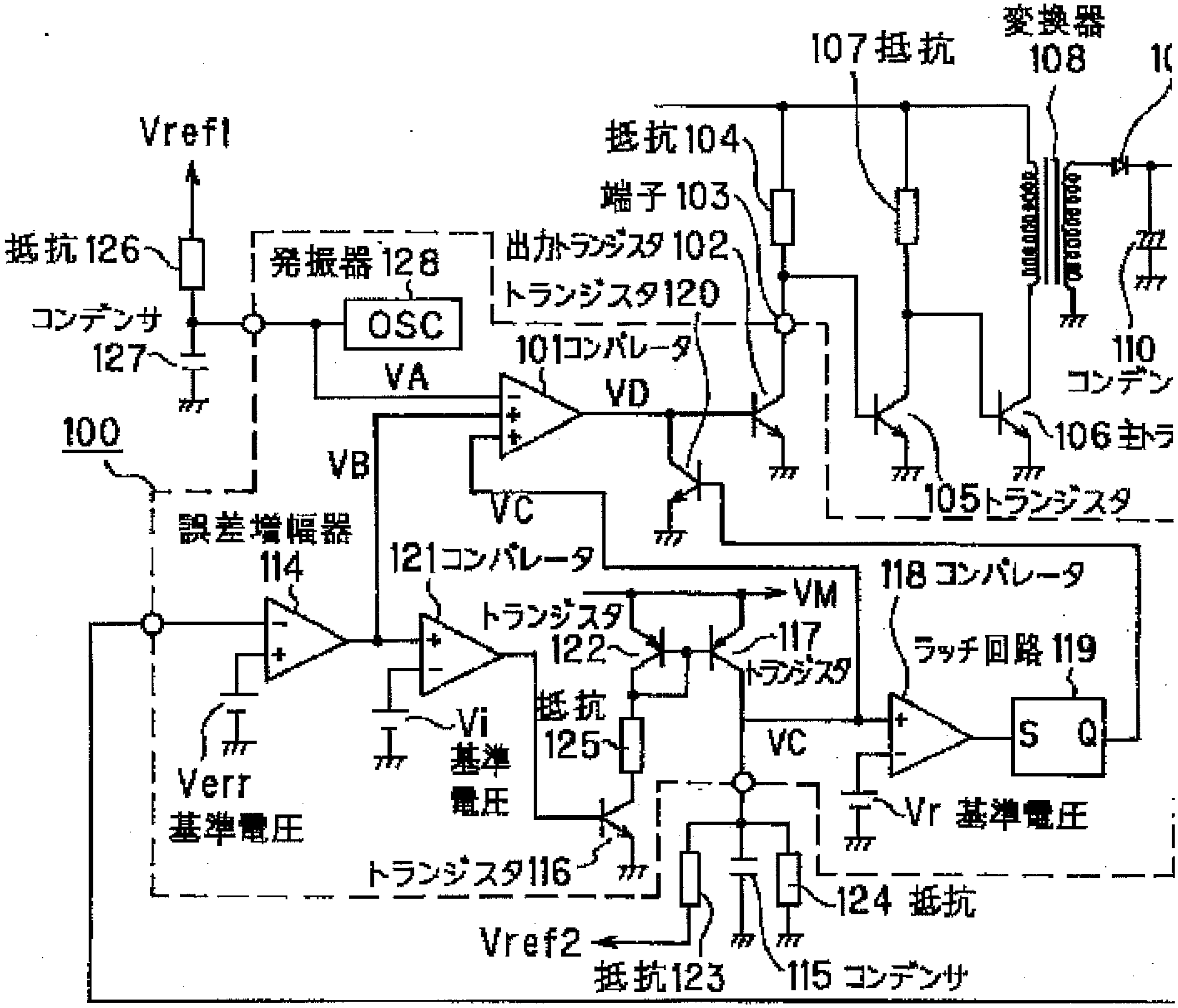

(d) ON／OFF
(b) 出力電圧Vo
(c) 電流Io
(d) 過小電流信号Vmin
(e) 過電圧信号Vp2
(f) 遅延回路信号Vdd
(g) 遮断信号Voff
C
D
時間

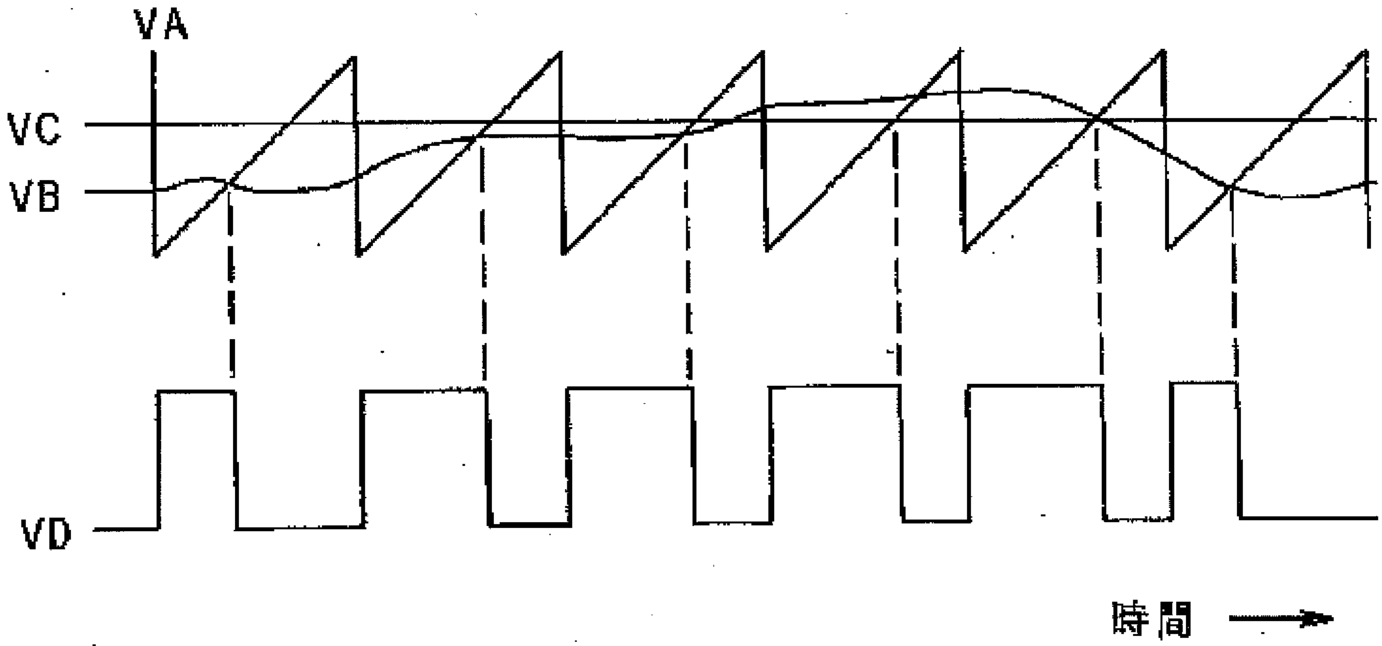

(a) ON／OFF
(b) 出力電圧Vo
(c) 電流Io
(d) 過小電流信号Vmin
(e) 過電圧信号Vp2
(f) 遅延回路信号Vad
(g) 遮断信号Voff
E
時間

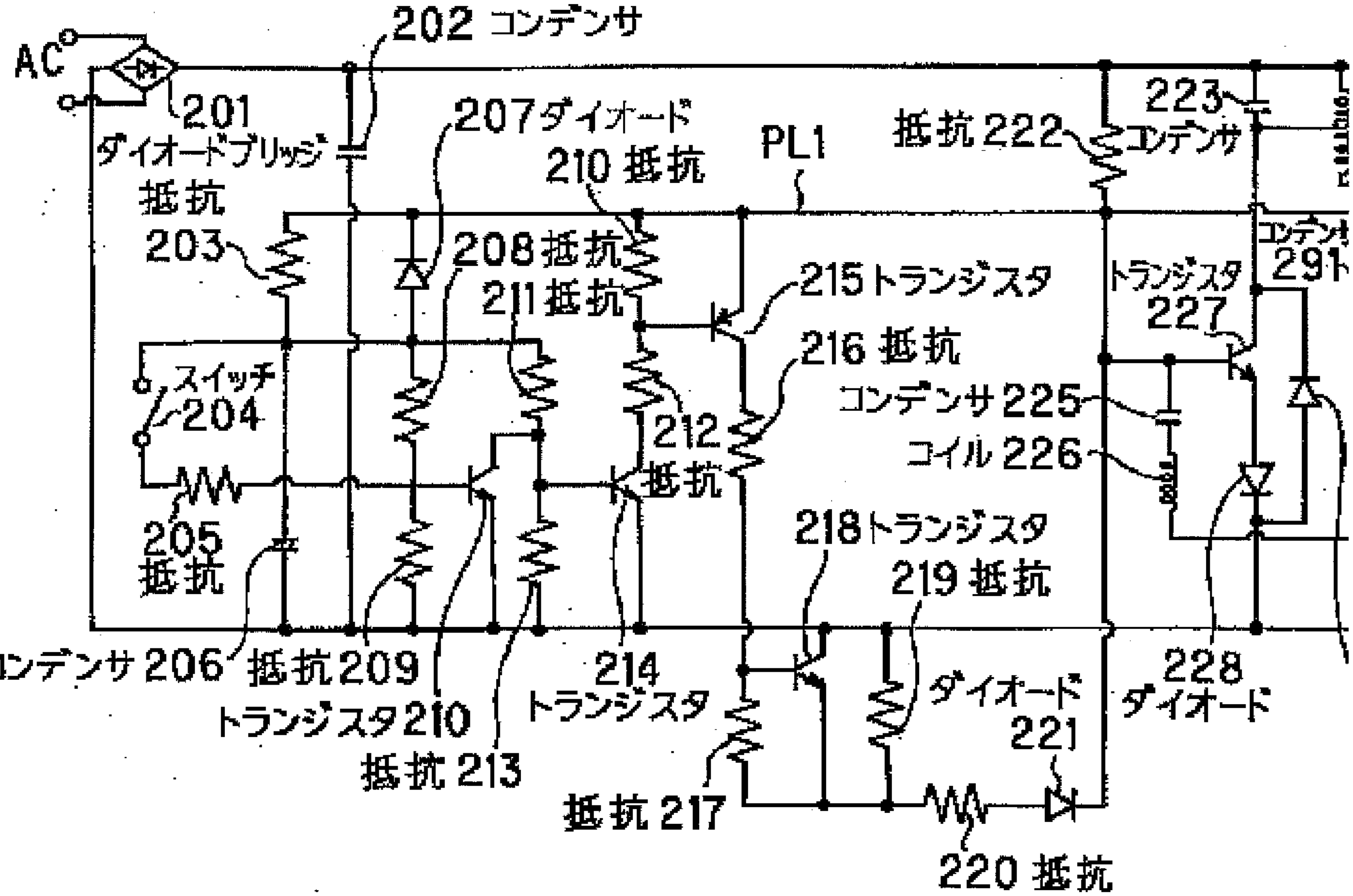

VA
VC
VB
VD
時間

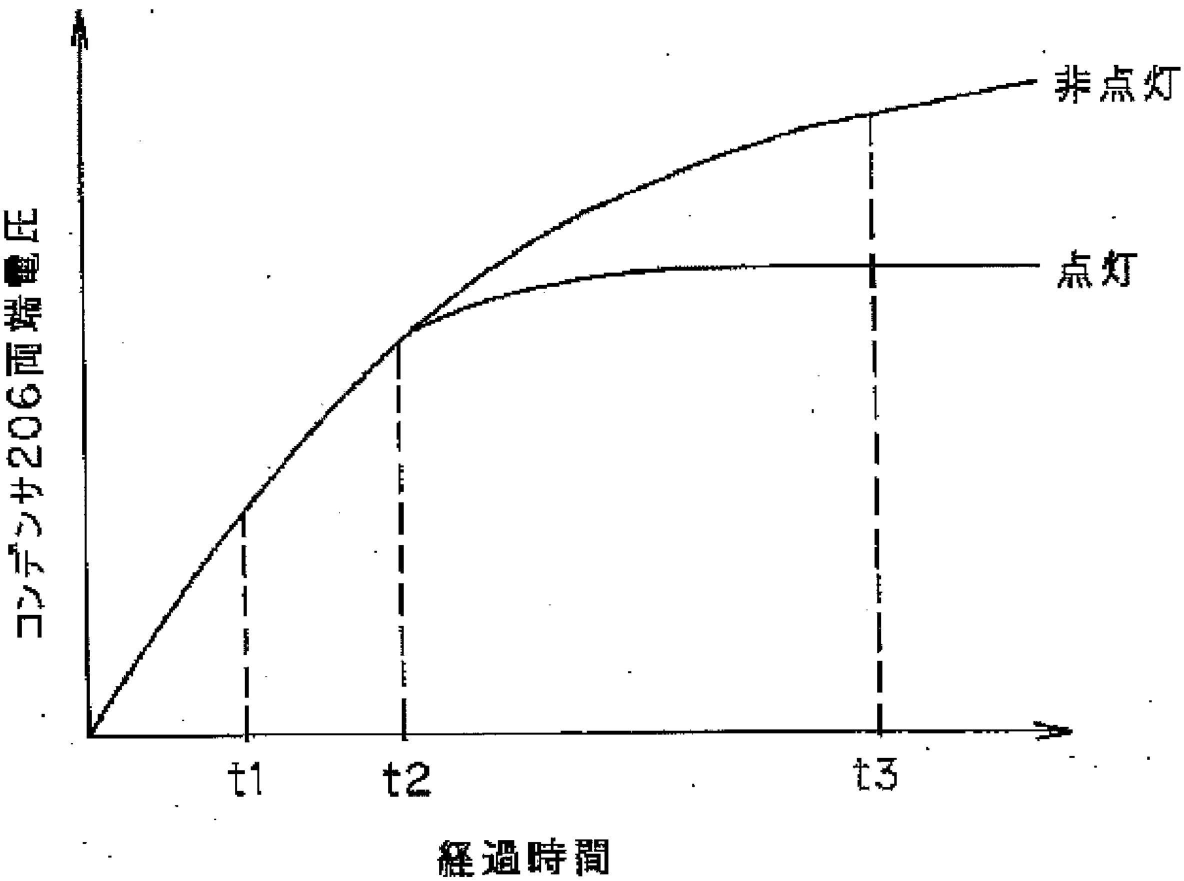

311
304
VDD
ヒューズ
Fu
駆動電圧
制御回路
昇圧回路
301
310
過電圧
保護回路
303
Vp1
Vo
IC
415
414
ON/OFF
周波数
制御回路
負荷
302
Io
Vp2
403c
403e
413
Vs 基準電圧
403b
403d
Is
401 過小電流
検出回路
403f
408
407
405
404a
404c
404b
403a
406c
404
整流回路
400
410
409
406b
406a
403
遮断回路
406
411
402 遅延回路
412

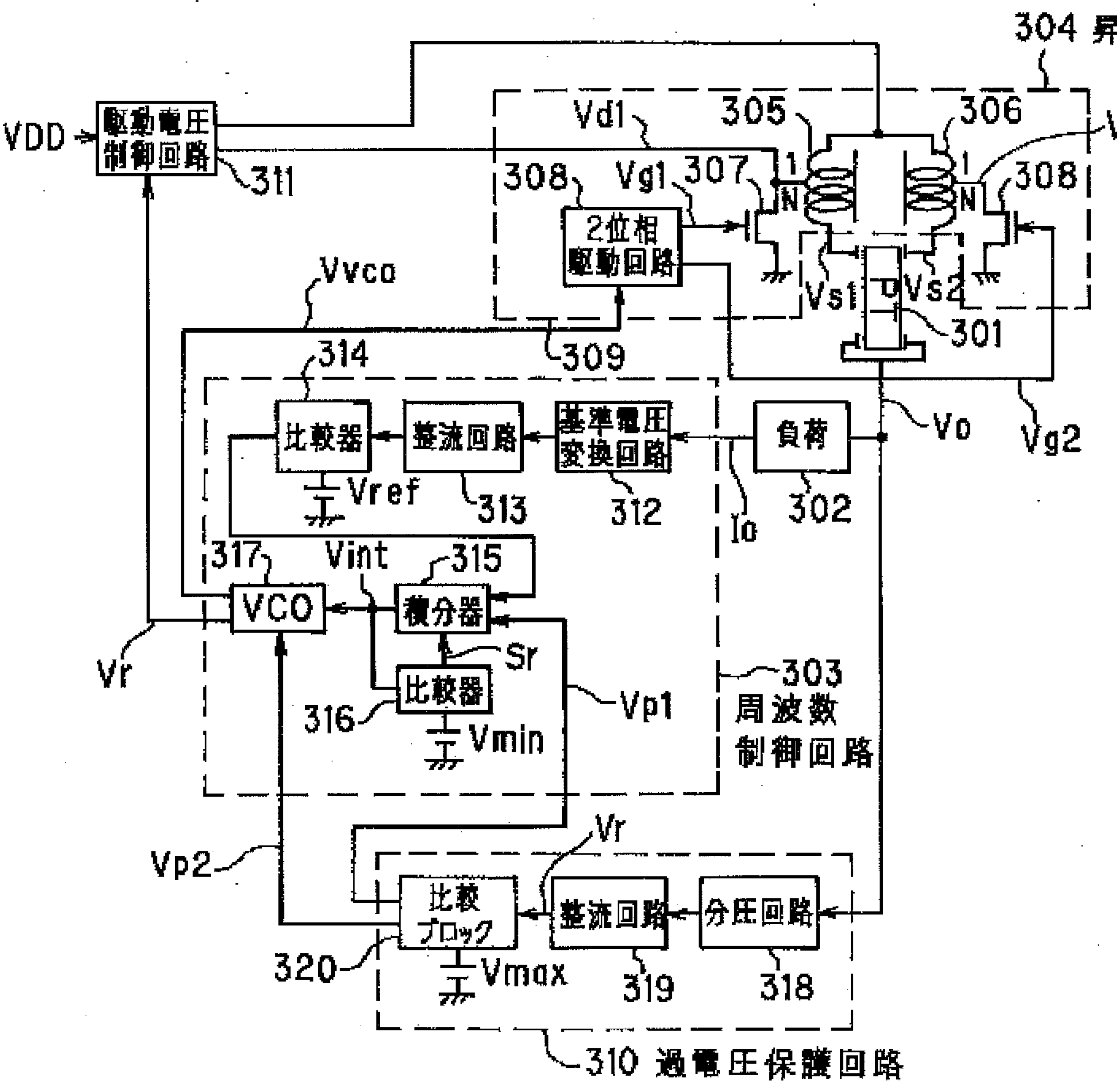

311
ヒューズ
VDD
駆動電圧
制御回路
307
305
2位相
駆動回路
310
Vs1
OPEN
309
過電圧
保護回路
IC
303
Vp1
415
414
ON/OFF
周波数
制御回路
負荷
302
Io
Vp2
403c
403b
403e
413
Vs 基準電圧
403d
407
Is
401 過小電流検出
404a
403f
408
405
403a
406c
404
404c
404b
400
410
整流回路
409
406a
403
遮断回路
406b
411
402 遅延回路
412


変換器
108
107抵抗
抵抗104
端子103
出力トランジスタ102
トランジスタ120
Vref1
抵抗126
コンデンサ
127
発振器128
OSC
VA
101コンパレータ
VD
VB
VC
100
110
コンデンサ
106主トラ
105トランジスタ
誤差増幅器
114
121コンパレータ
トランジスタ
122
117
トランジスタ
VM
118コンパレータ
ラッチ回路119
S
Q
抵抗
125
VC
Vi
基準
電圧
Verr
基準電圧
Vr 基準電圧
トランジスタ116
124 抵抗
Vref2
抵抗123
115 コンデンサ

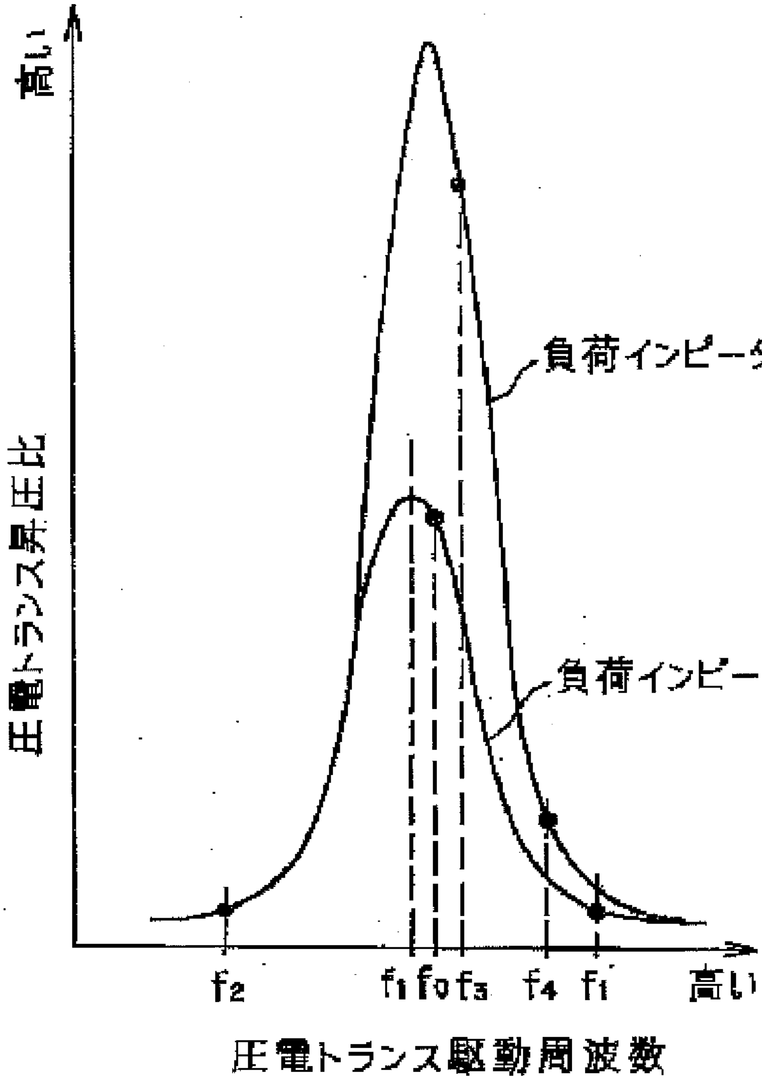

VA
VC
VB
VD
時間

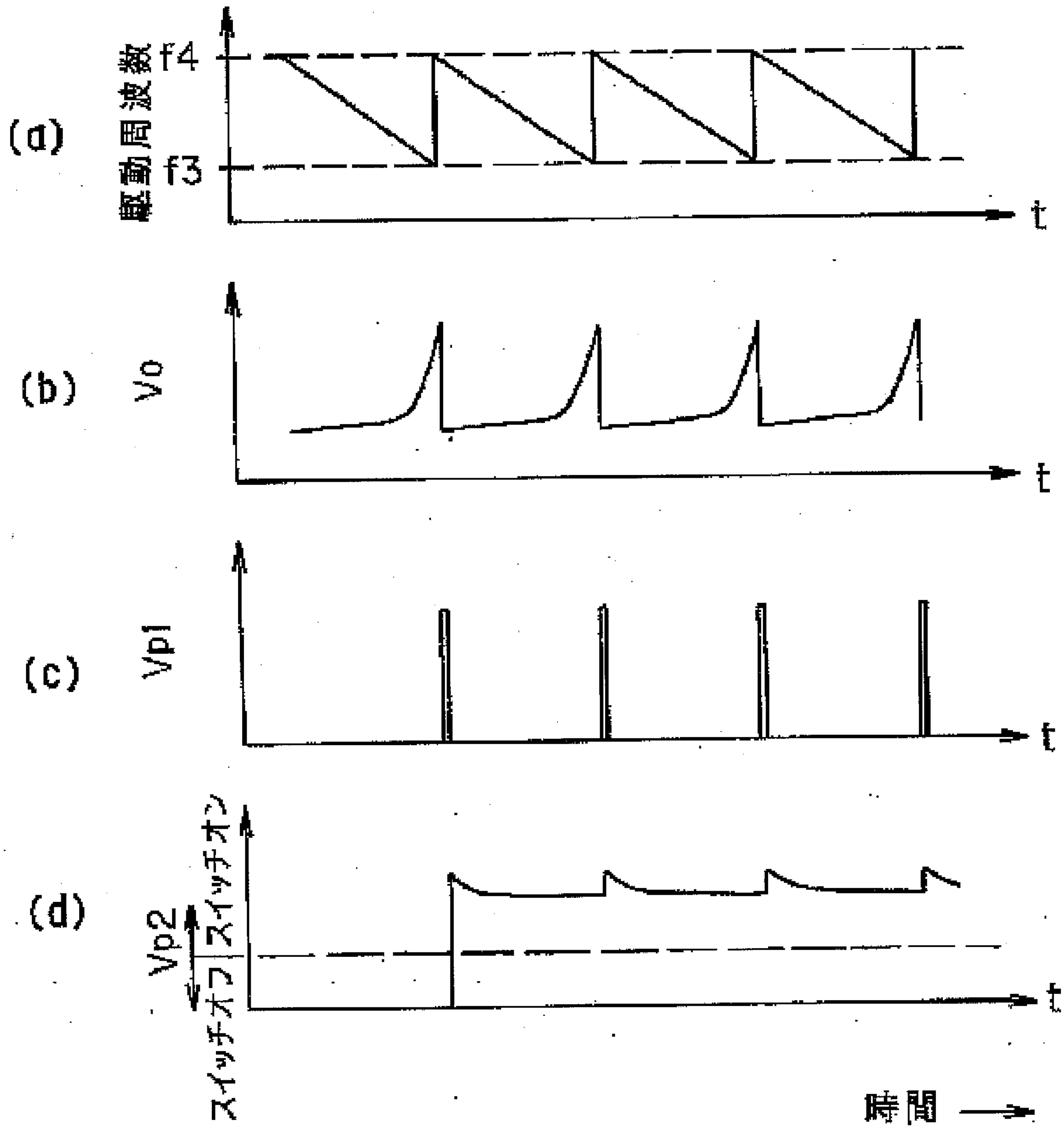

202 コンデンサ
AC
201
ダイオードブリッジ
207ダイオード
210 抵抗
PL1
抵抗 222
223
コンデンサ
抵抗
203
208抵抗
211抵抗
215トランジスタ
トランジスタ
227
291
216 抵抗
スイッチ
204
コンデンサ 225
コイル 226
212
抵抗
205
抵抗
218トランジスタ
219 抵抗
コンデンサ 206
抵抗209
214
トランジスタ
ダイオード
221
228
ダイオード
トランジスタ210
抵抗 213
抵抗 217
220 抵抗


非点灯
点灯
コンデンサ206両端電圧
t1
t2
t3
経過時間

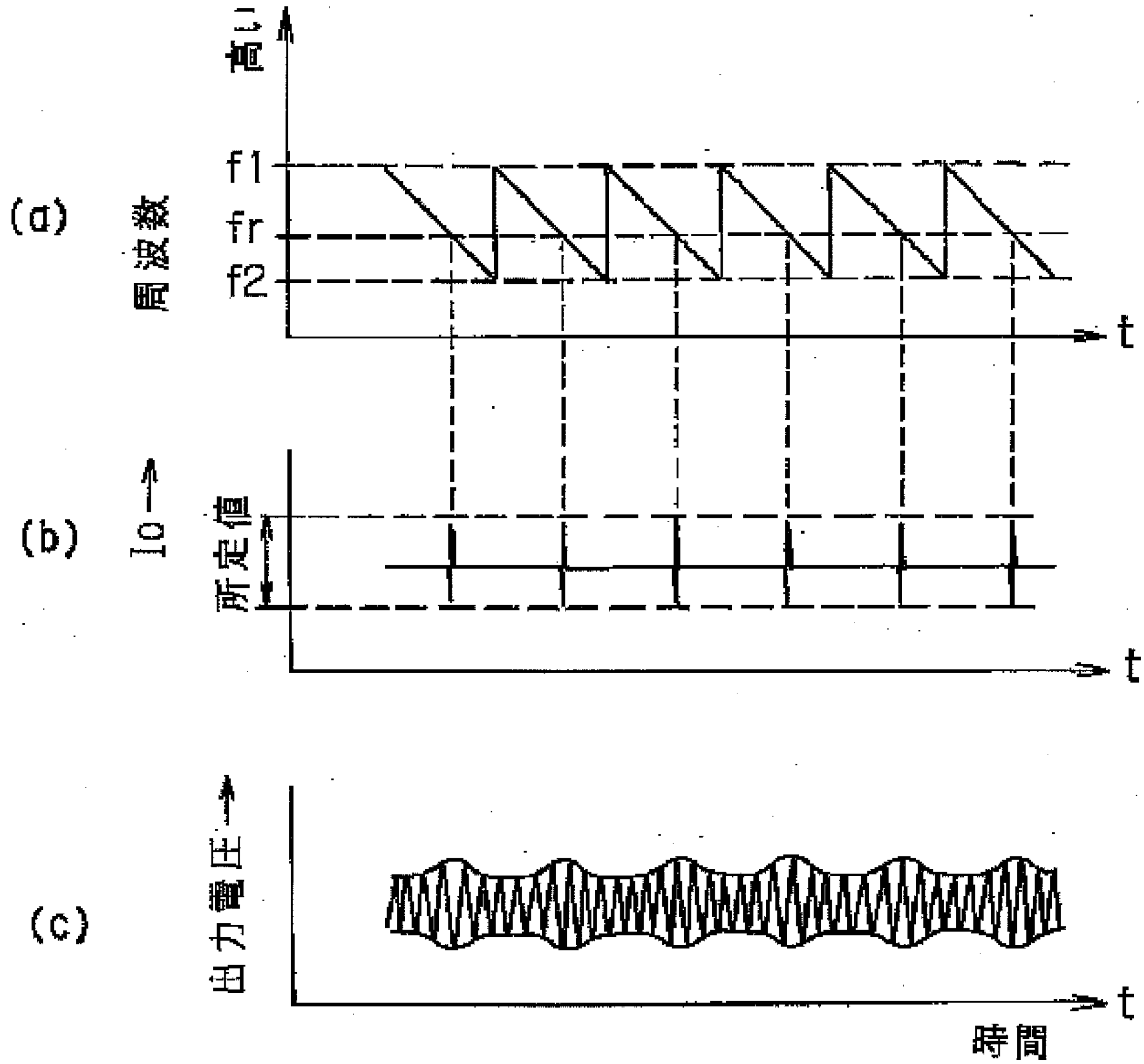


304 昇
VDD
駆動電圧制御回路
311
Vd1
305
306
308
Vg1
307
2位相駆動回路
1
N
Vs1
Vs2
301
Vvco
309
314
比較器
整流回路
基準電圧変換回路
負荷
Vo
Vg2
Vref
313
312
302
Io
317
Vint
315
VCO
積分器
Sr
Vr
比較器
316
Vmin
Vp1
303
周波数制御回路
Vp2
比較ブロック
整流回路
分圧回路
320
Vmax
319
318
310 過電圧保護回路


高い
圧電トランス昇圧比
負荷インピーダンスが高い時
負荷インピーダンスが低い時
f2
f1
f0
f3
f4
f1
高い
圧電トランス駆動周波数



(a)
駆動周波数
f4
f3
t
(b)
Vo
t
(c)
Vpl
t
(d)
Vp2
スイッチオン
スイッチオフ
t
時間


(a)
周波数
高い
f1
fr
f2
t
(b)
Io
所定値
t
(c)
出力電圧
t
時間